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Scheduling Locomotive Repairs

at the Silvis Shops of the C. R. I. & P. Ry.

By Frank W. Curtis
Western Editor, *American Machinist*

Planning repairs to be handled—Schedule board used for routing work — Reporting delays — Departmental material deliveries

THE majority of production shops, where thousands of similar pieces are being manufactured continually, have incorporated systems for scheduling work from raw material to the finished product, so that by quick reference it is possible to determine the production that may be expected from any particular unit. Time studies, based on actual operating conditions, usually form the foundation of such systems so that all estimates are made from the quantity of work that can be produced with given equipment. Charts or scheduling boards often are used to record the results obtained.

At first, it may seem difficult to apply such a system to the shopping of locomotives, because the work is of a varied nature and the quantity of similar units is small. In spite of these drawbacks, the Silvis shops of the Chicago, Rock Island and Pacific Ry. have worked out a system of scheduling locomotive repairs that covers the work from the stripping to the completely erected engine. The system has been in operation slightly over two years and is considered a valuable aid in repairing locomotives systematically, as well as being responsible for a reduction of repair costs through the increased production obtained.

A Report of Progress

In brief, the system shows the day in which the various operations should be accomplished, the conditions of each unit of the locomotive being repaired, the total progress made on each locomotive, whether or not the work is progressing according to schedule, and the causes of delay.

First, a time study was made of all operations, including stripping, machine work and erecting, in order to determine the total time required for making the major repairs. Then the time required for repairing certain units and assembling them into place was made, allowing in these estimates the necessary time for transportation and minor delays that are generally encountered on such work. With these data as a standard or master sheet, it is possible to schedule a locomotive through the shop in an estimated length of time and issue a date of delivery.

Advance Planning Helps

Having this information available, the next step is to plan the work required. An engine to be handled under major repairs is generally reported from 60 to 90 days before it is shopped. The condition of the engine and the repairs required are listed on a special form by the master mechanic so the shop can determine the work that is to be done and the material required for repairs. A reserve list of material required for a group of engines to be handled during a certain month is made out from the master mechanic's report. Patterns and stock numbers are used in all cases for ordering. An attempt is made to give the stores department sufficient time to have all the required material on hand when it is needed.

The master schedule board, shown in Fig. 1, is arranged in two sections, of which only one division is illustrated. The board shows the operation, the date, the engine number and a record of the completed work. There are 56 major operations placed in the center of the board, while to the right, in a horizontal line, there are listed the dates of the month, with provisions for inserting blue tickets under each date to the left of the major repair, for each locomotive being shopped. On the left-hand side of the major operation, provisions are made for listing the completed work.

Fig. 1—Master schedule board used for routing work

As soon as a locomotive arrives for repairs, all the operations from that time on are followed on the master schedule board. The engine is taken to one of the stripping pits where 10 days are allowed to perform the stripping and to make a close inspection of detailed repairs. This work constitutes the first seven operations listed on the schedule board. As these operations are required on each engine to be repaired, tickets bearing the engine number are placed to the right of the operations, and under the respective dates when they are to be completed.

As soon as the operations are completed, the foreman reports the condition of the units to the scheduling department, where the completion date is marked on the ticket of the master board. The ticket then is moved to the left-hand side of the major operations. The tickets for a given locomotive are arranged in a vertical line directly under the locomotive number that is listed on the top. If an operation passes the schedule date, a red ticket is used to fill the gap at the left-hand side of the board. This marking indicates at a glance what is holding up the repairs so the schedule department can notify the department responsible for the delay and thereby remind it that all efforts must be made to complete that particular unit.

The inspection of the locomotive, made during the

Table I—Master Schedule Board Dates

No.	Operation	Days	No.	Operation	Days
1	Engine blocked	3	29	Wheeled	5
2	Stripping	4	30	Jacket applied	5
3	Machinery inspection	4	31	Steam and exhaust pipes applied	4
4	Units removed	5	32	Cab and running boards applied	4
5	Flues removed	8	33	Shoes and wedges applied	4
6	Boiler inspection	10	34	Motion work	4
7	Boiler shell O K	13	35	Tank O K	4
8	Firebox—FS—SS—DS—O K	13	36	Air pump applied	3
9	Tender in and unloaded	12	37	Grates applied	3
10	Cylinder and valves O K	10	38	Side rods applied	3
11	Frames and braces O K	10	39	Lubricators applied	3
12	Flues applied	9	40	Injectors applied	3
13	Boiler O K to test	8	41	Safety valves applied	3
14	Dry pipe and throttle applied	8	42	Cab fittings applied	3
15	Guides O K	8	43	Tender trucks O K	3
16	Motion work O K	8	44	Tender frames O K	3
17	Crossheads O K	8	45	Tender O K	2
18	Pistons O K	7	46	Ash pans applied	2
19	Valves O K	7	47	Front end O K	2
20	Driving wheels assembled	7	48	Main rods applied	2
21	Trailer wheels O K	7	49	Brake rigging applied	2
22	Engine truck O K	7	50	Piping applied	2
23	Main reservoirs tested	7	51	Air brake equipment applied	2
24	Boiler tested O K	7	52	Headlights O K	1
25	Units in and tested	6	53	Valves set	1
26	Spring rigging applied	6	54	Break in	1
27	Lagging applied	6	55	Painting O K	1
28	Cylinder closed	5	56	Final O K	0

stripping operation, makes possible a detailed description of the condition of the locomotive, and the balance of the schedule may be made accordingly. The estimates are governed by the longest time required for a major operation. This estimate being completed, it is possible to determine the out-date of the locomotive by merely consulting the schedule guide that gives the length of time required for each class of work, based on time studies, as previously mentioned.

In Table I is shown the master scheduling guide and the time required in days for performing the operations. To illustrate the method, assume that engine No. 2656 is received on Jan. 2 for repairs. The schedule shown in Table II is made out to include the first seven stripping operations. The date for the completion of this work is Jan. 13. Upon inspection it is found necessary to include fire-box repairs consisting of flue sheets and side sheets, No. 8, that are shown to require 13 days, by referring to the master schedule guide. Then, adding 13 days to Jan. 11, and allowing for Sundays, the final O.K. date is estimated to be Jan. 28. From this operation, designated No. 56, the complete schedule is filled in by working backward to operation No. 8, all the dates being filled in by subtracting the number of days required for each operation as shown on the master schedule guide, Table I. At this point the scheduling for the repairs of the engine is complete and the master schedule board can be arranged with a complete set of tickets bearing the engine number, as mentioned, for the first seven operations.

Since all the tickets showing the completion of an operation are moved from the right- to the left-hand side of the board, it is an easy matter to check the original schedule dates against the actual completion dates as the work progresses. If an operation is not completed on time it does not signify that the locomotive will be delayed for the final O.K. For example, assume that operation No. 16 is held up three days for a link rod. The other work can proceed as usual and when the delayed part is received it can be assembled accordingly. On the other hand, such a delay may retard the entire schedule, and this condition is one of the chief advantages of the schedule board, inasmuch as it is possible to determine the cause of the delay and who is to blame. At the end of the month the total delays are added together and subdivided respectively under material and machining delays. This total gives a check of the inefficiencies encountered.

In addition to the master schedule board each department responsible for locomotive repairs is equipped with a departmental board showing the work handled in the department. These boards, such as shown in Fig. 2, are similar to the master board with the exception of the left-hand portion, this part being omitted. The dates on the departmental boards are checked daily by the routing department. If a foreman is unable to complete a unit in a given time he is obliged to turn in a report immediately showing the cause of the delay. This report is called the four o'clock report of material delays. If the delay is caused by lack of material, the

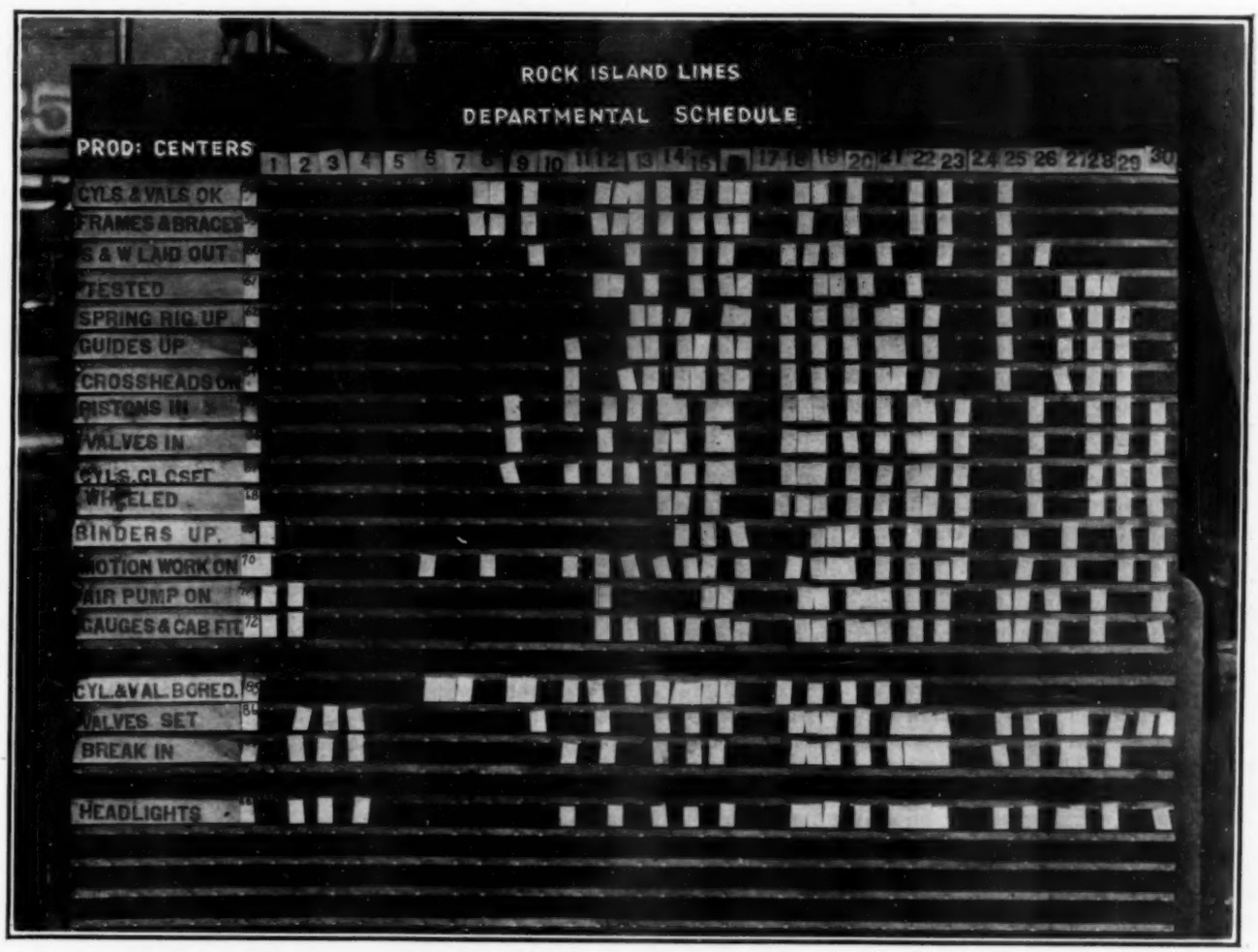

Fig. 2—Departmental schedule board

Table II—Master Schedule Sheet

Eng. No. 2656	Class of Repair 3	In Jan. 2	Out Jan. 30

	Master Operation	Due Date	Act. Date		Master Operation	Due Date	Act. Date
1	Engine blocked	Jan. 2	Jan. 2	29	Wheeled	Jan. 22	Jan. 24
2	Stripping	Jan. 4	Jan. 7	30	Jacket applied	Jan. 22	Jan. 26
3	Machinery inspection	Jan. 4	Jan. 8	31	Steam and exhaust pipe applied	Jan. 23	Jan. 25
4	Units removed	Jan. 7	O K	32	Cab and running boards applied	Jan. 23	Jan. 26
5	Flues removed	Jan. 11	Jan. 10	33	Shoes and wedges applied	Jan. 23	Jan. 25
6	Boiler inspection	Jan. 13	Jan. 13	34	Motion work	Jan. 23	Jan. 26
7	Boiler shell O K	O K	O K	35	Tank O K	Jan. 23	Jan. 26
8	Firebox—FS—SS—DS—O K	Jan. 13	Jan. 16	36	Air pump applied	Jan. 25	Jan. 27
9	Tender in and unloaded	Jan. 14	Jan. 18	37	Grates applied	Jan. 25	Jan. 28
10	Cylinder and valves O K	Jan. 16	Jan. 18	38	Side rods applied	Jan. 25	Jan. 28
11	Frames and braces O K	Jan. 16	Jan. 16	39	Lubricators	Jan. 25	Jan. 27
12	Flues applied	Jan. 18	Jan. 18	40	Injectors applied	Jan. 25	Jan. 27
13	Boiler O K for test	Jan. 19	Jan. 19	41	Safety valves applied	Jan. 25	Jan. 27
14	Dry pipe and throttle	Jan. 19	Jan. 20	42	Cab fittings applied	Jan. 25	Jan. 28
15	Guides O K	Jan. 19	Jan. 23	43	Tender trucks O K	Jan. 25	Jan. 27
16	Motion work O K	Jan. 19	Jan. 23	44	Tender frames O K	Jan. 25	Jan. 28
17	Crossheads O K	Jan. 19	Jan. 25	45	Tender O K	Jan. 26	Jan. 27
18	Pistons O K	Jan. 20	Jan. 23	46	Ash pans applied	Jan. 26	Jan. 27
19	Valves O K	Jan. 20	Jan. 23	47	Front end O K	Jan. 26	Jan. 27
20	Driving wheels assembled	Jan. 20	Jan. 25	48	Main rods applied	Jan. 26	Jan. 27
21	Trailer wheels O K	Jan. 20	Jan. 25	49	Brake rigging applied	Jan. 26	Jan. 27
22	Engine truck O K	Jan. 20	Jan. 20	50	Piping applied	Jan. 26	Jan. 27
23	Main reservoir tested	Jan. 20	Jan. 21	51	Air brake equipment applied	Jan. 26	Jan. 27
24	Boiler tested O K	Jan. 20	Jan. 26	52	Headlights O K	Jan. 27	Jan. 28
25	Units in and tested	Jan. 21	Jan. 26	53	Valves set	Jan. 27	Jan. 28
26	Spring rigging applied	Jan. 21	Jan. 26	54	Break in	Jan. 27	Jan. 29
27	Lagging applied	Jan. 21	Jan. 27	55	Painting O K	Jan. 27	Jan. 30
28	Cylinders closed	Jan. 22	Jan. 26	56	Final O K	Jan. 28	Jan. 30

scheduling department follows it up by investigation at the stores department. Sometimes the stores department claims to be out of certain material, that, upon further investigation by the scheduling department, is found to be on hand.

The list of all material holding up the various locomotives is given to the stores department daily. On this report is marked the daily progress made in obtaining the shortages. The stores department must show on this report if the material is ordered or if it has been received or give some remarks as to when it may be expected.

The material-delivery department is controlled by the scheduling department since this branch of work is directly responsible for the completion of a locomotive on a given date. The trucking consists of four power trucks of which three are gas and one electric, together with the necessary trailer equipment. The truckers are instructed carefully as to the requirements and importance of prompt delivery. In many cases they can deliver to advantage both going and coming, which is not always the case when each department has its own trucker. All the material handled by these truckers is marked by red and blue tags. The red tags designate finished material to be delivered to the stores department and the blue tags signify that the material is of interdepartmental nature and carry marks showing designations.

When new material is required, the foreman writes out an order and places it in a box used exclusively for the purpose. The box is located in his department. The orders are gathered each hour by the material dispatchers, working under the scheduling department. The orders then are turned over to the stores department for delivery through the truckers who deliver at the required location. In the event the stores department cannot furnish the material, the requisition is signed by the stores department foreman and returned to the scheduling department. Shortages are followed daily until the material is delivered. The foremen of the machine shop, erecting shop, and boiler shop assist the routing foreman in supervising the truckers as they go to and from their respective departments.

Twice a week the general foremen of the departments responsible for the parts scheduled have a meeting to discuss all the delays that may exist and suggest remedies, if possible, to eliminate further delays.

The departmental board gives the foreman of each department a lineup of what he has to complete each day, while the master schedule board gives the shop management the entire situation including all delays. The scheduling system has become a valuable asset to the organization and is responsible for handling repairs more efficiently in less time than was heretofore required.

Award for Reed Propeller

The Collier trophy for 1925 has been awarded to the Reed metal propeller. This propeller is now known all over the world and, in addition to being a standard of equipment in service airplanes here, is used extensively abroad. Much of the responsibility of winning for and maintaining in the United States, the speed records of the world, belongs to Dr. S. Albert Reed through the use of the propeller on the Curtiss racing planes, and the all-round excellent characteristics of the Reed propeller continue to maintain for it a world-wide reputation.

There have been many attempts at making metal propellers in the past, as all recognized the inherent weakness of wood for the purpose, but it remained for Dr. Reed to design, and for the Curtiss Aeroplane and Motor Co. to develop and manufacture it on a commercial basis. The methods of manufacture were described in the *American Machinist* of Dec. 24, 1925.

The Design of Gear Tooth Forms

By Earle Buckingham

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Massachusetts Institute of Technology

Construction of the line of action from a given tooth profile and the reverse—Requirements for interchangeable tooth forms — Discussion of the cycloid curve

IN THE preceding examples, separate drawings were made to construct the line of action, the profiles of the basic rack, and the conjugate gear tooth profile. In actual practice, separate drawings are not necessarily required. These were made here so that the several operations would be more apparent.

PROBLEM 4—*Given an arbitrary rack profile, to construct the line of action and conjugate gear teeth forms.*

The arbitrary rack form selected will be the arc of

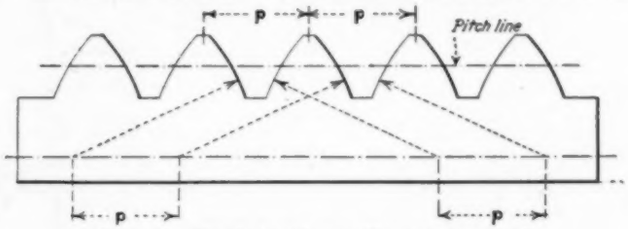

Fig. 6—Rack tooth profile constructed with circular arcs

a circle as shown in Fig. 6. To construct the line of action, lay off even intervals along the pitch line of the rack. Through these points, draw the profile of the rack. As this profile is the arc of a circle, the centers of these profiles must also be established. These successive profiles will be numbered as before to identify them, and the corresponding centers of the profiles will also be numbered accordingly. From the pitch point lines are drawn normal to the rack profile in each of its successive positions. As these profiles are arcs of a circle, the normal line will be one which passes through the center of the circle. The intersection of each normal with its rack profile establishes a point of contact, or one point on the line of action. The line drawn through all of these intersection points is the line of action. This has been done at *A* in Fig. 7. A study of this illustration should make clear the process of constructing the line of action for any rack form.

The construction of the mating conjugate gear tooth profiles is shown at *B* in Fig. 7. Pitch diameters of the desired size are drawn, and angular intervals, whose lengths of arcs on these pitch circles are equal to the intervals on the rack pitch line, are layed off. The intervals on the pitch lines of the conjugate gears are numbered in the reverse order to those on the pitch line of the original rack, and represent the successive pitch points as the original rack moves along to the corresponding positions. To determine the profiles of the conjugate gear teeth, a series of similar triangles are constructed. From pitch point *9'* on the conjugate gear an arc is drawn equal in radius to the distance from the pitch point to contact point *9* (shown at *A*). From the center of the conjugate gear another arc is drawn, equal in radius to the distance from the corresponding center at *A* to the contact point *9*. The intersection of these two arcs give a point on the profile of the conjugate gear. Other points of the conjugate gear tooth profiles are established in the same manner. At

The second article. The third will appear in an early issue.

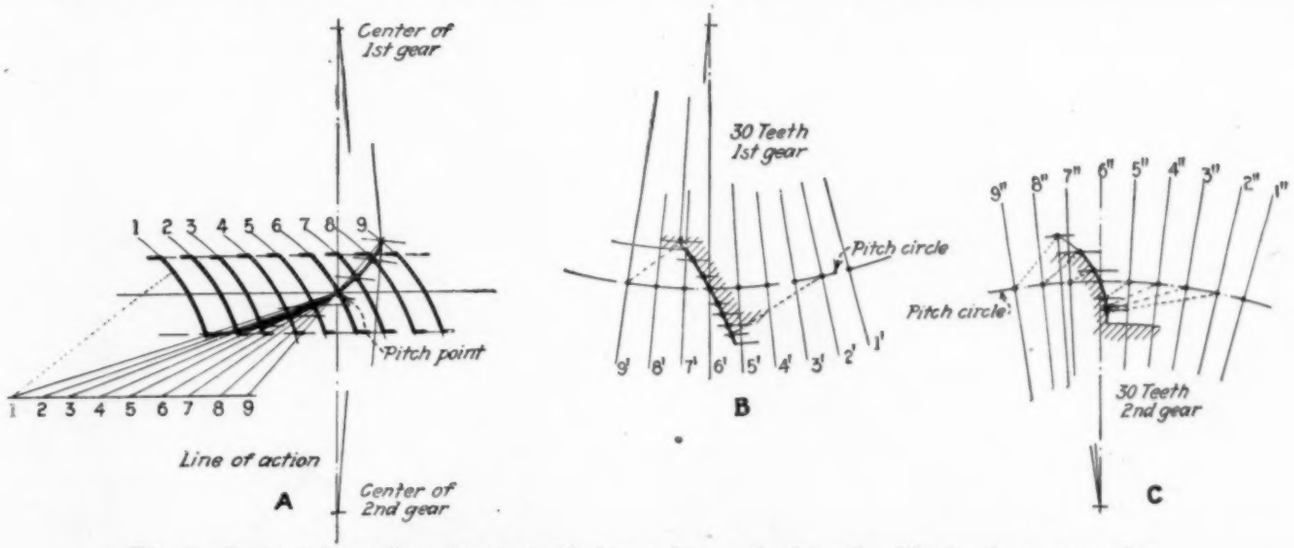
Center of 1st gear
1 2 3 4 5 6 7 8 9
Pitch point
1 2 3 4 5 6 7 8 9
Line of action
A
Center of 2nd gear
30 Teeth 1st gear
Pitch circle
9' 8' 7' 6' 5' 4' 3' 2' 1'
B
9" 8" 7" 6" 5" 4" 3" 2" 1"
Pitch circle
30 Teeth 2nd gear
C

Fig. 7—Construction of conjugate tooth forms from a basic rack with circular arc profiles

B and *C* in Fig. 7 are the two conjugate gear tooth forms that will run with each other, and also with the basic rack: the profile at *B* mates with the outside surface of the rack as drawn, and the profile *C* mates with the inside surface or the reverse of the rack as drawn in Fig. 6.

PROBLEM 5—*Given an arbitrary line of action, to construct the basic rack form.*

This is a problem difficult to solve. The following statement appears in Grant's *Treatise on Gearing*: "When the line of action alone is given, the odontoids (conjugate gear tooth profiles) for given pitch lines are fully determined, but there seems to be no simple graphical method of constructing them except for special cases."

The following method can be used, however, to get an extremely close approximation to the conjugate profiles. The larger the scale of the drawing, and the closer the intervals that are used, the closer the approximation will be. As a matter of fact, it is possible to carry this approximation to the point where errors of execution will introduce much greater errors than those of the method itself. This method is based on the assumption of uniform curvature of the profile of the basic rack between two successive intervals. The amount of error introduced by this method, therefore, depends upon the amount of change of curvature in the profile of the basic rack between two successive intervals, a change which is usually very small.

In Fig. 8 is shown an arbitrary line of action with a given pitch line. The first step is to lay off equal intervals along the pitch line, which are numbered for identification. The next step is to draw semicircles through each interval and the pitch point. It is not necessary to draw the complete semicircle, as an arc of it which intersects the line of action and the pitch line is sufficient. A line drawn from the pitch point to the intersection of the semicircle and the line of action will be a normal to the basic rack form. A line connecting the intersections of the semicircle with the line of action and the pitch line, will be perpendicular to the normal, as this line and the normal are inscribed in a semicircle, and will therefore be tangent to the basic rack profile when moved to that specific position. Such tangents are shown in Fig. 8, numbered for identification.

The next step is to build up the basic rack profile from these tangents. Intervals are established half way between the original intervals, and lettered for identification. These are arcs of semicircles through the pitch point and the intermediate intervals on the pitch line. Lines parallel to the pitch line are next drawn through the intersections of these arcs with the line of action and lettered to correspond. We are now ready to build up the profile of the basic rack from the tangents.

Through the pitch point a line is drawn between the parallel lines *f* and *g*, this line being perpendicular to the line of action at the pitch point. This gives the first section of the profile of the basic rack. From the intersection of this line with *ff'*, another line is drawn to *ee'*, parallel to the tangent *6*. This gives the second section of the basic rack profile. The same process is repeated until the entire profile of the basic is completed. A study of Fig. 8 should make the method clear. This method gives the profile as a series of straight lines. A smooth, curved line would be drawn, tangent to all these straight line sections, which would represent the profile of the basic rack.

Once the basic rack profile was established, the forms for conjugate gear teeth could be constructed in the same manner as illustrated in Fig. 7.

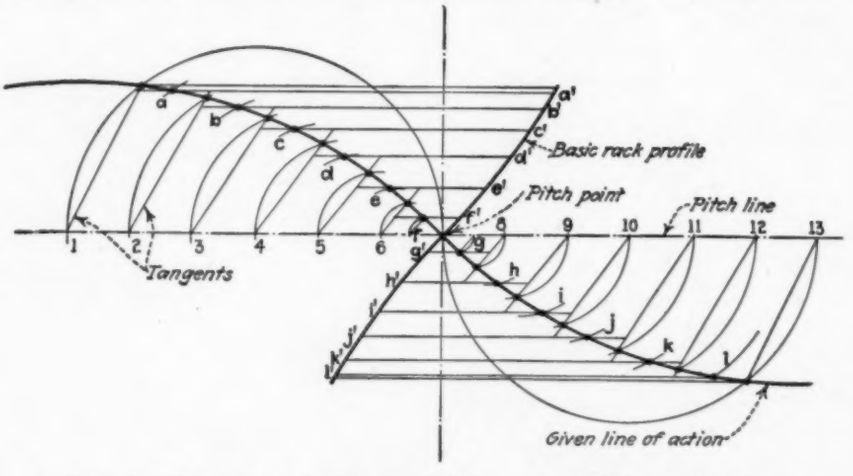

Fig. 8—Basic rack profile derived from a given line of action

LIMITATIONS TO CONJUGATE ACTION

When the shape of the line of action is such that a tangent circle can be drawn to it with the center of the gear as its center, conjugate tooth action must cease at the point of tangency to avoid interference. Conjugate action can take place only along the line of action. Referring to *A* in Fig. 9, if the diameter of the gear is carried beyond the tangent circle *a* to the dotted line, the portion of the tooth beyond the tangent circle cannot come into proper action because correct contact cannot exist away from the line of action. The same condition exists at *B* in Fig. 9. Correct contact cannot take place below the tangent circle *c*. In order to avoid interference, the outside of the mating gear must not extend beyond the radius *b*, which is drawn from the center of the mating gear to the point of tangency of the circle *c* with the line of action.

REQUIREMENTS FOR INTERCHANGEABLE TOOTH FORMS

No consideration to the subject of interchangeability was given in the preceding example. For example, the gear tooth form shown at *B* in Fig. 7 will mate properly with gear tooth form shown at *C*; but two gears with the same tooth form as shown at *C* will not run together properly. In order to obtain this interchangeability between gears, their line of action must be symmetrical in relation to the pitch point. When this condition is met, the profile of the basic rack is symmetrical about its pitch line, and all gears of all numbers of teeth that are conjugate to such a basic rack will also be conjugate to each other. In Fig. 8, the line of action is symmetrical in relation to the pitch point, and the profile of the resulting basic rack is symmetrical in relation to the pitch line. Thus all gears which are conjugate to this basic rack will also be conjugate to each other.

One of the first regular curves used for gear tooth

profiles was the cycloidal form. Theoretically it has many points of advantage. The practical difficulties of accurately producing it, however, are responsible for its retirement from the field of commercial gears.

Wilfred Lewis has said: "The practical consideration of cost demands the formation of gear teeth upon some interchangeable system. The cycloidal system cannot compete with the involute, because its cutters are formed with greater difficulty and with less accuracy, and a further expense is entailed by the necessity for more accurate center distances. Cycloidal teeth must not only be accurately spaced and shaped but their wheel centers must be fixed with equal care to obtain satisfactory results."

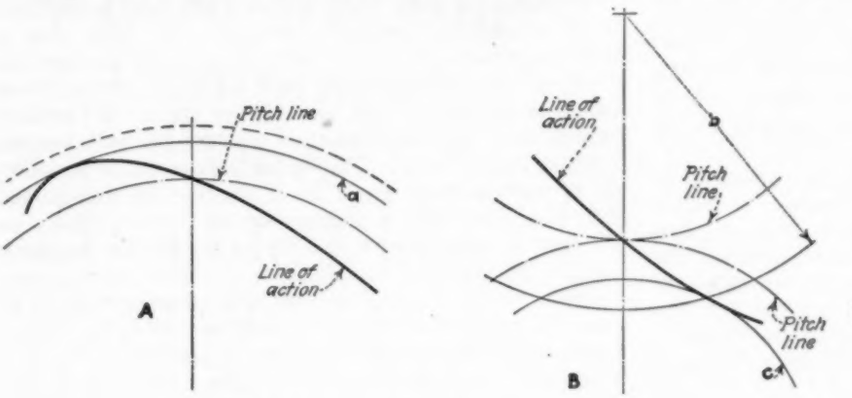

Fig. 9—Limits of conjugate tooth action

George B. Grant wrote in his excellent *Treatise on Gearing*: "There is no more need of two different kinds of tooth curves for gears of the same pitch than there is need for two different threads for standard screws, or two different coins of the same value, and the cycloidal tooth would never be missed, if it were dropped altogether. But it was first in the field, is simple in theory, is easily drawn, has the recommendation of many well-meaning teachers, and holds its position by means of 'human inertia,' or the natural reluctance of the average human mind to adopt a change, particularly a change for the better."

Although cycloidal forms are seldom used today for gear tooth profiles, they are widely used for impellors of pressure blowers and for other special applications. Their action in these cases is conjugate gear tooth action, although the actual rotation of the shafts is usually controlled by other gears. A brief analysis of these cycloidal forms seems, therefore, to be in order.

Babbitt Successfully Used for a Stressed Machine Part

By E. R. Plaisted

Necessity is the mother of invention and expediency often stands god-mother to some most unorthodox practices in machine construction.

In general, abrasives should not be permitted to get in between machined surfaces, but it is sometimes easier to take care of them there than to keep them entirely out just as the oyster turns the irritating grain of sand into a pearl. Especially is this true in the case of granite-working machinery, where chilled steel "shot" is flying freely and sometimes works its way into most unexpected places.

In a machine of this type it became desirable to increase the diameter of some upright raising screws, having nuts of babbitt metal poured into cast-iron shells which were in turn set into cylindrical sockets from which they could be easily removed. These shells had a flange cast on one end, and a threaded ring screwed on the other end. It was impossible to increase their outside diameter without replacing one of the largest and most expensive parts of the machine.

The use of brass was suggested, but if the steel shot got onto the screw threads in a brass nut they would score the screw, or the nut, deeply. They would merely imbed themselves in soft babbitt metal, however, and would do no appreciable harm.

Therefore the solution of the problem seemed to be the use of a nut made entirely of babbitt, cast in the same size and shape—outwardly—as the iron shell, and with the same threaded iron ring screwed on one end. The question was whether or not it would be strong enough.

Babbitt metal is largely lead, which has a rated tensile strength of only 2,000 lb. per sq.in.; tin is rated at 3,500 lb. per sq.in. The formula we used contained lead 57 per cent, tin 32 per cent, and antimony 11 per cent. When we tried to break one of these nuts in the testing machine it took eleven tons to force off the flange, and ten tons to push the threaded ring off the opposite end, although the area of the broken section was less than two and one-half square inches. The babbitt nut design has been adopted as standard.

Always More to Come

By Loring Roper

You'd think, to hear some people talk,
Prosperity was done
That we were through with building things,
When we have just begun.

They think because the motor plants
Don't double every year,
As they did once, long days ago,
That times ahead look drear.

They're used to orders long and loud
For tools in hefty batches
And can't think straight on other things
Like ice machines or matches.

They plumb forget most everything
No matter where you find 'em
Has lathe, and miller, tap or drill
Somewhere mixed up behind them.

And whether it be home or shop
On road or railroad train
Behind them stands some shop machine,
Conveyor, tool or crane.

As long as carpet sweepers hum
As autos run the road
Machines we'll build of many kinds
To carry on the load.

The Art of Resigning —Discussion

By W. Roland Needham
Goodmayer, England

TOGETHER with excellent advice upon the art of resigning wisely, J. Nuerman, in an article under the title given above, on page 608, Vol. 63, of the *American Machinist*, makes out an admirable case for friend Jack Jones not resigning. Difficult as it is for some men to bring themselves to the correct concert pitch whence resigning becomes a matter of practical politics, it is still more difficult for others not to resign. If there is an art of resigning there is no less an art of not resigning.

The notes which follow may well be regarded by some as a species of Mr. Worldly-Wiseman proverbs, and be dismissed accordingly with high disdain. Certainly they who favor the idler dilettantism of the famous R.L.S. cult, will have no use for anything so crassly utilitarian as the present writer urges. It has to be remembered, however (and the writer yields to none in his admiration of the sterling merit of that famous essay in "Virginibus Puerisque"), that the men directly concerned are none of them the darlings of fortune. Bread and butter and a roof to shelter them are of the elemental needs in their life. Often it is not only their own bread and butter either. It is men such as these the present writer has in mind.

It is almost always wise to think twice ere speaking once. This very trite and horribly hackneyed sentiment is most pertinent. Where this is the rule, the fool speech, which at times brings hardship to those best loved, dies stillborn. The fool action, which fools later regret bitterly, is not undertaken.

Tactful Disagreement

Such thought often accompanies another prime desideration—that of being able to appreciate the other fellow's position. Reverting to R.L.S., it was said of Stevenson he could not be a politician for he would find himself, as often as not, agreeing with his opponents. This ability to appraise the excellencies of another's methods and ideas is a gift to cultivate. Then a man is not always trying to queer the pitch for his chief; it is good when he can recognize in that chief, a man whose ideas are worth-while and whose instructions are sound. In any case he will obey; and if at any time he does so under protest, against his better and mature judgment, he will make that protest tactfully and so as not to strain good feeling and correct relationships. Also, like the tactful wife, he will find that in this loyalty to his chief, he is often getting his own way in a measure and to an extent otherwise impossible. Such an attitude and temper of mind has a quite surprising effect upon reasonable persons. The chief usually learns to trust such a man, to set store by his opinion. It is an excellent testimonial for a man when his foreman can depute him as safe, one to be trusted, and who may be relied upon to act with judgment and decision.

The arts of resigning and of not resigning are adequately learned only in conjunction with the equally important art of weighing matters. In fact, this last is probably the more important of all. In learning how to appraise things, one forms the useful habit of seeking to make the best case of what opportunities offer. In time, this habit becomes almost second nature, and when this happens the scope of opportunity is seen to enlarge its bounds in a manner that once would have seemed surprising in the extreme. The time will probably come when the call is to pastures new. There the same law operates. But the worker is able to form a really intelligent opinion as to pros and cons. He certainly is in good case to make good use of whatever offers either here at hand, or there further afield.

Wherever a man goes he takes himself with him, is an exceedingly pertinent truism. It's good that a man, especially one with a natural aptitude for getting "fed up" should remember that when he gets a fresh job, it is he himself who has to work there. He needn't expect that by some magical change he will become another kind of man. This thing, of course, is possible; or it may be that he is in a position of exceptional difficulty, and that a change of environment may be all that is necessary. But if, as frequently happens, he is a disgruntled, awkward or perverse person, then he does well to remind himself that wherever he is he can only hope to get along tolerably well with his fellows when he shows a little restraint, toleration and accommodation; when he learns to swallow his grouse; and to give as well as to take. This he may do any time he elects, possibly as well in his present job as in any other that has to be tried. The second, even the third, best we know, may be better than the uncertainty we do not know but are tempted to try. If it be a really bad patch one has struck, then prudence and common sense urge one to move on. To resign today is better than to be asked to resign tomorrow. Coming events may cast their shadows before them. A wise man will seek to forestall such an undesirable contingency. The effect on his own morale is a point to consider. To be fired, is a matter of little concern to men of a certain temperament; upon others it has most serious and devastating consequences. The latter may easily lose nerve, and it may take long months for them to recover their self-confidence. If they can anticipate such an event, the ill effects will be more transient and less deep seated, and they will have the glow of at least a negative kind of success to warm them.

Refused to Be Fired

In parenthesis, the writer recalls the case of a youth he knew who refused to be fired. In a period of depression several draftsmen were given a fortnight's notice. The youth was one of the unfortunates. For some days his natural buoyancy forsook him and he sought other work assiduously. He was not successful, but regained his cheerfulness nevertheless. The Monday following the expiration of the fateful fortnight, saw him in his accustomed place in the office. The sub or section leader gave him a job, and when the chief noticed him some days later, he was hard at it. *And he stuck there.*

If possible, ere leaving one job, make sure there is another job to go to. If this simple expedient were attended to, much hardship to a man and to his family would be averted. It means often that a man will pause ere downing tools in a sudden emergency. Many a man who has allowed his wrath to simmer down, has been thankful ere the night has come. Many another has wished he had had the sense to hold himself in check.

The arts of resigning and of not resigning are best studied in relation to the art of weighing matters.

Automotive Production

Where Machine Equipment Does Double Duty

By Fred H. Colvin
Editor, *American Machinist*

Some of the methods used by the Rickenbacker Motor Co. in machining cylinder blocks for both 6- and 8-cylinder engines on the same machines

THE economical production of any product depends largely upon the machine equipment of the plant. But the kind and extent of the equipment must depend upon the output expected, and it is an easy matter to so over-equip a small plant as to make the machine overhead eat up all the savings of actual production costs. It is for this reason that the machine equipment and the methods of the Rickenbacker Motor Co., both as to engine design and machining operations, are of special interest at this time.

Great care was exercised in selecting machine equipment for the first car, the 6-cylinder model, and when it was decided to build the eight-in-line engine, the shop influence was strong enough to secure a design of cylinder block that could, for the most part, be easily machined on the equipment originally bought for the six. Just how this was accomplished will be shown in this article, and it is quite an achievement for those responsible for both equipment and machining costs. With very few exceptions, all of the operations on the cylinder blocks of both engines can be done on the same machines and without changing the tooling.

Ingersoll milling machines surface the cylinder blocks, using nine cutters at once. Four of the cutters are shown in Fig. 1 and the other five in Fig. 2. They mill the top and bottom of the block, the side for the valve cover plates and the seats for the caps for the

SEQUENCE OF OPERATIONS

Cylinder Blocks

Pickle
Sand blast
Mill top and bottom, rough and finish
Mill cap seats, rough and finish
Mill valve cover plate and manifold pads
Drill and ream two ½-in. location holes
Mill both ends
Straddle mill main bearings except inside of rear main bearing
Bore cylinders
Ream cylinders
Drill and bore welch-plug holes—bore and face water-inlet pad and assemble welch plug
Water test
Drill all bolt holes in head face
Drill all water holes in head face
Drill all holes in valve side, except front camshaft-bearing lockscrew- and manifold-stud holes
Drill all holes in base and cap seats
Drill all holes in both ends
Counterbore and tap stud holes
Assemble bearing caps
Bore and ream crank holes
Bore and ream cam holes
Line ream camshaft holes
Mark and disassemble bearing caps
Mill oil groove in caps
Drill holes in sides and ends
Tap all holes in both ends and sides
Tap all holes in top and base
Mill oil groove in main bearings
Drill and ream bearing dowel-holes
Drill distributor-shaft hole in top
Drill water-pass holes
Rough bore valve-throat hole and spot drill. Drill valve-bushing hole
Ream valve-bushing hole and finish throat hole
Spotface underside of valve-bushing hole
Counterbore 45-deg. at valve hole
Press in bushings
Profile push-rod guide seat and seat for distributor-drive bracket
Mill slot for push-rod guide
Mill seat for oil-relief body
Wash
Enamel and bake
Ream valve-guide bushings and face
Line ream camshaft hole
Grind cylinder bores and chamfer
Set cylinder-head studs
Rough hone cylinder bores
Finish hone cylinder bores
100 per cent inspection

Cylinder Heads

Acid pickle
Profile bolt bosses and distributor pad
Mill joint face
Drill welch-plug holes and assemble plugs
Drill and spotface spark-plug holes
Water test
Tap spark-plug holes and countersink
Drill all bolt holes and distributor-shaft hole
Drill all water passholes
Mill fan bracket pad
Mill water outlet pad
Counterbore distributor-shaft hole and drill three, ⅜-16 holes
Drill and tap holes in water outlet
Tap three holes in distributor pad
Drill two $\frac{5}{16}$-in. water-pass holes
Wash
100 per cent inspection
Black enamel
Clean

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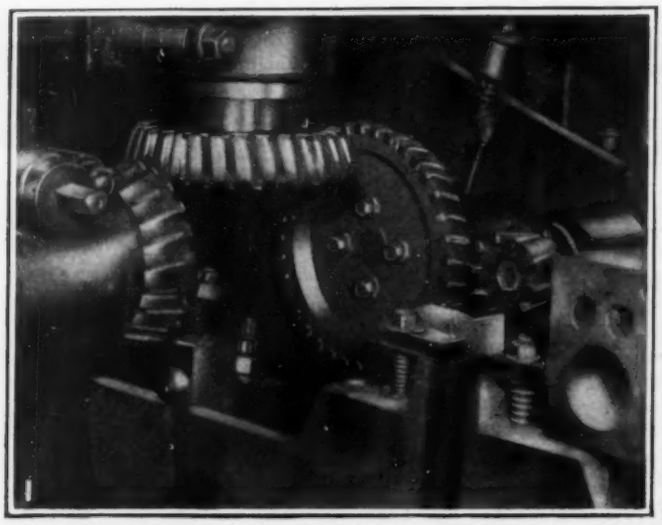

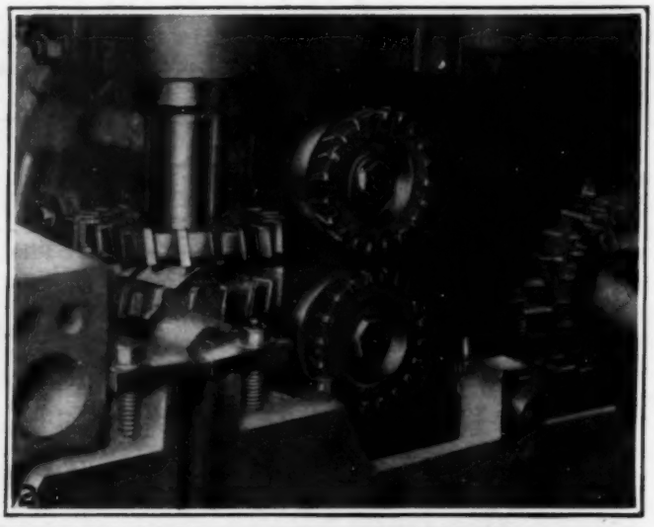

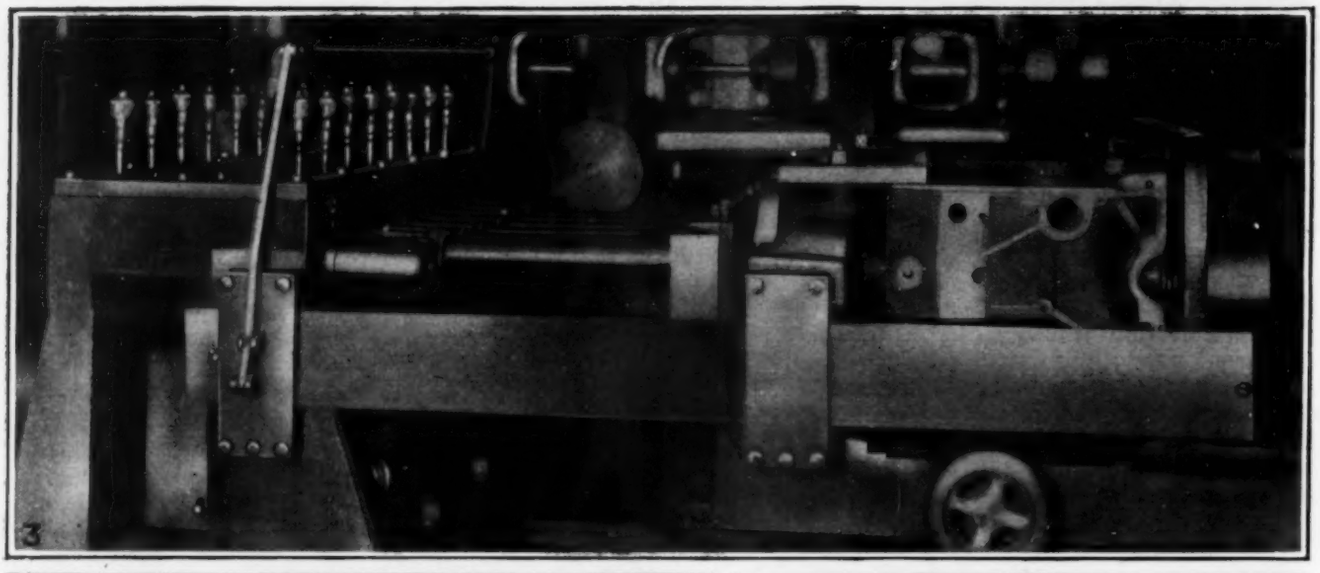

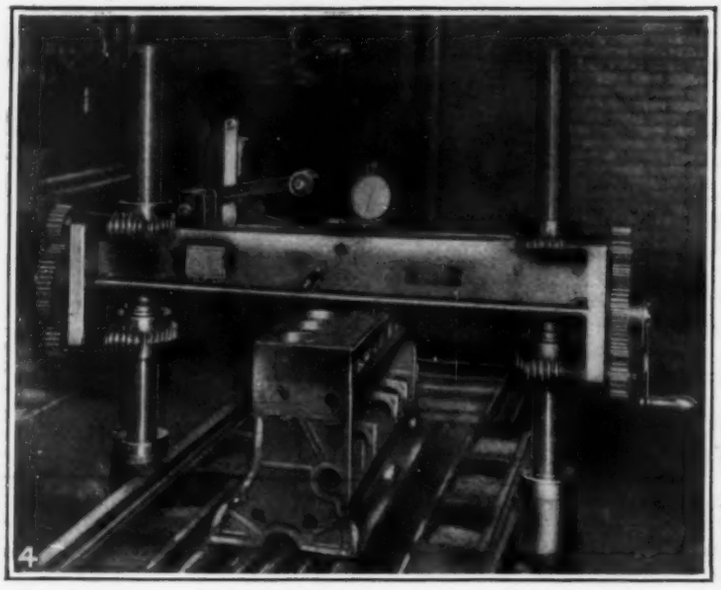

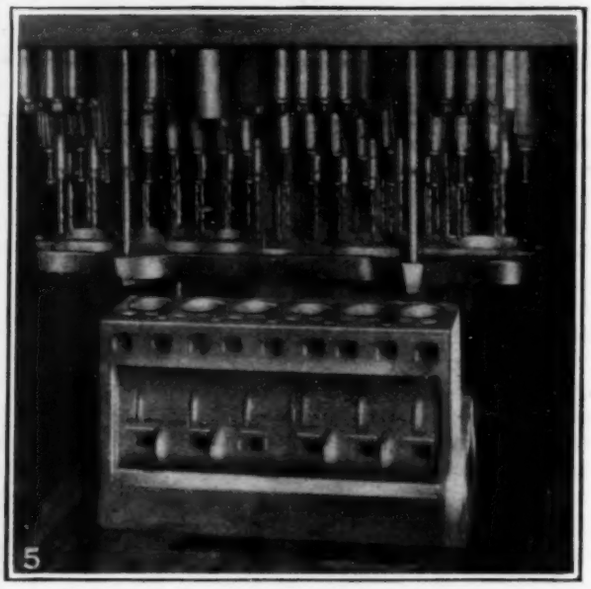

Fig. 1—One set of cutters for cylinders. Fig. 2—Cutters on the other side of the head. Fig. 3—Boring fixture with supported bars. Fig. 4—Testing hardness of cylinder iron. Fig. 5—Boring for crank and camshafts

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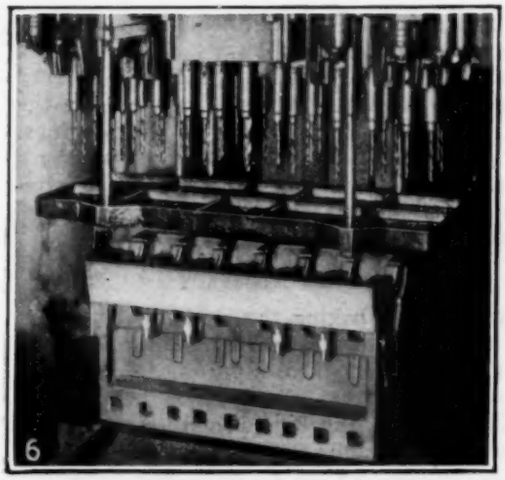

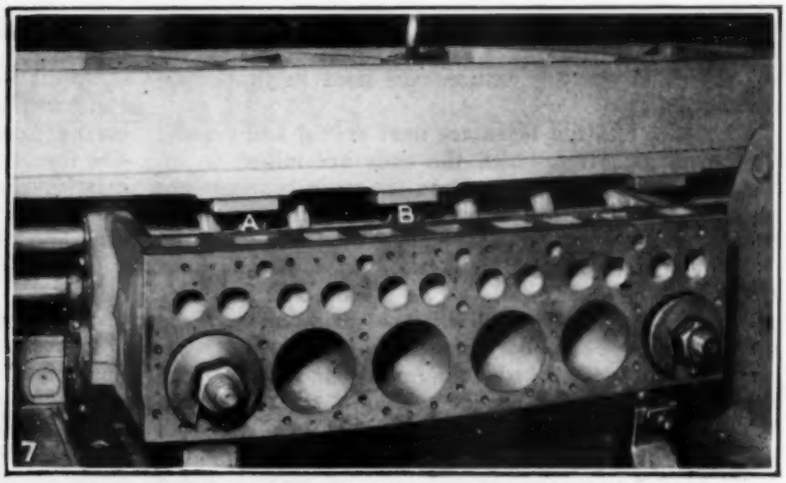

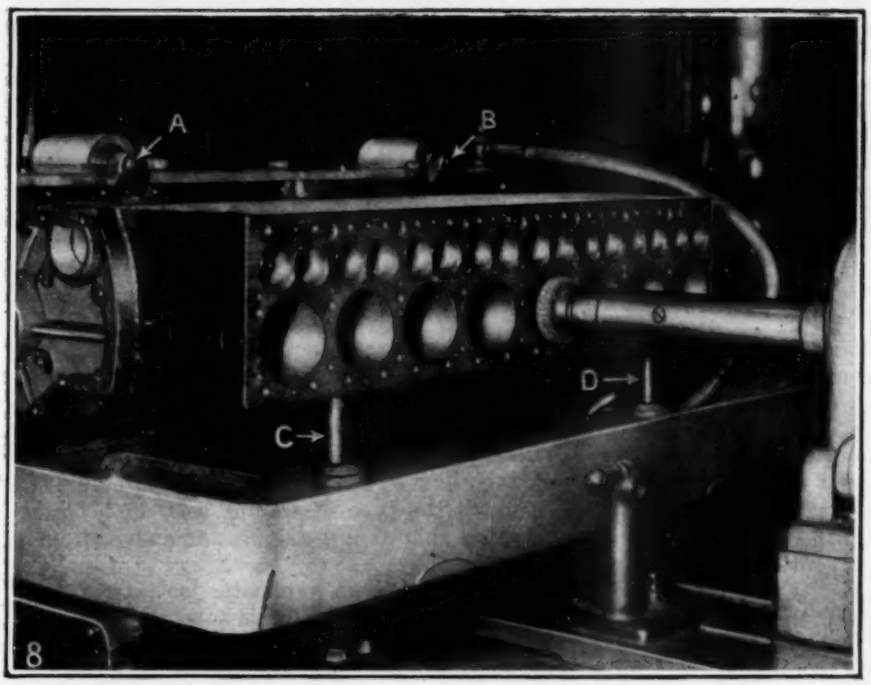

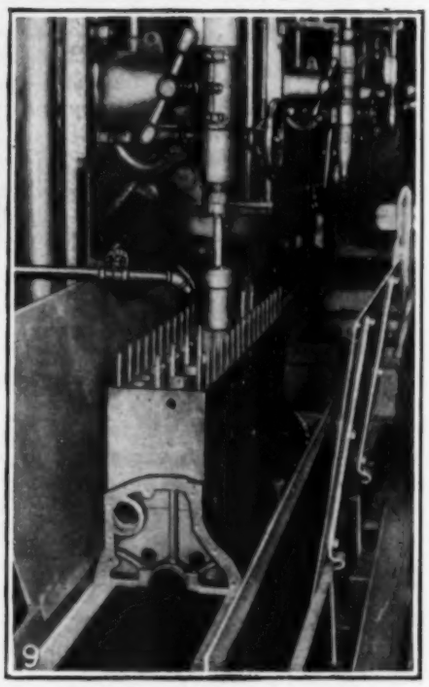

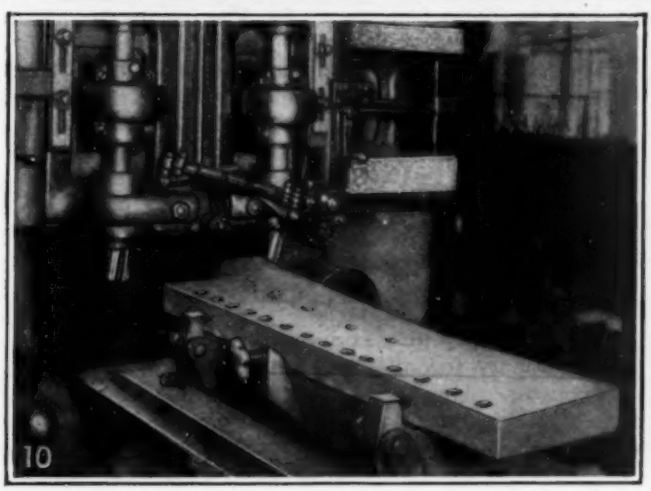

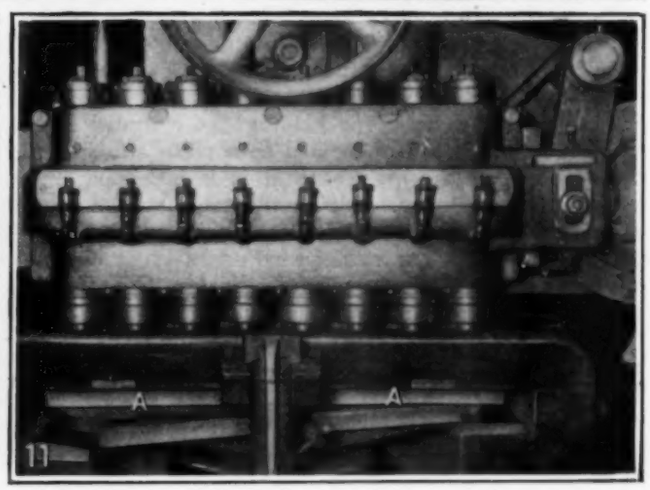

Fig. 6—Drilling for cylinder studs. Fig. 7—Drilling for bearing caps. Fig. 8—Fixture for cylinder grinding
Fig. 9—Honing the cylinders. Fig. 10—Profiling bolt bosses on head
Fig. 11—Machining the combustion chambers

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main bearings. These two views show the method of holding the cylinder blocks in the fixtures and the types of cutters used. Six fixtures are used in the string on the table.

Two ½-in. locating holes are next drilled and reamed in the flange, after which the ends are milled on an Ingersoll duplex machine. Then the main bearings are straddle milled with the exception of the rear main bearing.

The cylinders are bored in the fixture, Fig. 3, built on a heavy Bridgeford lathe as a base and used for power for the boring spindles. The boring bars extend through the cylinder bores and have substantial bearings at both ends to insure alignment and prevent the tendency to follow the bore of the cored hole. The cutting tools can be seen about to enter the block. It will be noted that neither the front nor the rear spindles carry boring bars, because the block in place is for a 6-cylinder engine. In boring the 8-cylinder block, an additional boring bar is placed in each of the outside spindles. In this way the same machine and fixture does duty for both types of engines. The cylinders are reamed to 3.241 in. with 3.243 in. as the maximum diameter. The bores are ground from 0.0005 to 0.0015 in. under the desired size, using either a 36-1 Precision or a 36-J Norton wheel. The cylinder studs are then set with an air drill. After drilling for and inserting the welch plugs, the block is water tested.

Testing for Hardness

The Rickenbacker Co. is very particular as to the kind of iron that goes into the cylinders, and every block is checked for hardness by the Rockwell hardness tester shown in Fig. 4. The mixture for the cylinder is nickel, at least one per cent; chromium, at least one per cent; silicon, 1.75 to 2.25 per cent; sulphur, not over 0.1 per cent; phosphorus, not over 0.1 per cent; manganese, 0.5 to 0.8 per cent; total carbon, 1.35 to 3.70 per cent. With this mixture the hardness is kept equivalent to a Brinell test of 189 to 207. The hardness test is made as the cylinder goes down the line from the machine that drills the locating holes, simply stopping on the testing machine long enough to have the reading taken.

The two drilling operations, Figs. 5 and 6, show the way in which both the 6- and 8-cylinder blocks can be handled on the same fixture. The work is done on Natco machines in which the drills are grouped for drilling the stud holes for holding the cylinder head. The guide bushings are carried in a plate attached to the head of the machine, so that it is necessary only to locate the cylinder block on the table by the usual dowels to have it properly positioned. It will be noted that the drills for the two end cylinders of an 8-cylinder block are already in place, so that either type of block can be handled at will. In a very similar way, the holes are drilled for the bearing cap studs. The holes for the crankcase bolts are already in place. The bolt-hole drills vary from ⅝ to ⅞ in., and the water-end drills vary from ⅝ to ⅝ in. The holes in the base, Fig. 6, vary from ¼ to ⅜ in. there being 36 in all.

The bearings for both the crankshaft and the camshaft are bored in the fixture shown in Fig. 7, the boring bars being seen in position behind the cylinder block. The crankshaft hole is 2.869 to 2.871 in. and the camshaft hole 2.047 to 2.049 in. The fixture is very rigid and has substantial supports, *A* and *B*, for the boring bars, that hold the bars close to the bearings. The top of the fixture is swung up out of the way by a hoist overhead. This fixture will also handle an 8-cylinder block as well as the six shown. The bearings are then line reamed with Martell reamers.

Hand Feed for Accuracy

After enameling and baking the block, the cylinders are ground on a Whitney cylinder-grinding machine, the grinding fixture being shown in Fig. 8. It is a simple fixture and one that allows rapid handling of the work. The clamps *A* and *B* hold the bottoms against the angle plate and the studs *C* and *D* support the front ends.

After grinding, the cylinders are honed in two operations, Fig. 9. In the first honing the hones are of 120 grit, while the finishing hones are of 180 grit. Six-bladed Hutto hones are used and run at about 150 r.p.m. Instead of having a positive mechanical traverse through the cylinder, the hones are fed by hand. The theory is that the operator can feel any portion of the bore that may be a trifle small and allow the hone to grind a little longer at that point. At any rate the result is a cylinder bore that is exceptionally good, the tolerance being only 0.0005 in. for diameter and out of roundness.

Profiling machines are used to a larger extent in the Rickenbacker shop than in most automotive plants. One of the jobs done on a profiling machine is shown in Fig. 10, where the bolt bosses on the top of the cylinder head are surfaced rapidly by means of the two end mills shown on a No. 12 Pratt & Whitney machine. This view also shows the type of clamps used to hold the head—the chisel shaped jaw gripping it and pulling it down on the fixture.

Another profiling job, an automatic job in this case, is seen in Fig. 11. The operation is surfacing the combustion chamber in the cylinder head, and either the 6- or the 8-cylinder head can be handled. An 8-cylinder head is shown in place at *A*. The fixture carrying the head is moved to the right or left by the cam *B* The fore and aft movement, is also controlled by a cam, as well as the vertical movement to bring the head up to the proper depth against the cutters. More attention is being paid to having combustion chambers of uniform volume, and also to have their surfaces finished, than formerly.

The few remaining operations will appear in another article in the near future.

Aluminum alloy pistons are now being used in large sized cylinders for oil engines. Pistons up to 14 in. in diameter have been used with complete success. Some of them have serrated expansion slots cored in each side and steel rings cast in place to help control expansion. With these rings the running allowance between piston and cylinder is the same as for cast-iron pistons.

Autogenous Welding of Aluminum and Its Alloys

By A. Eyles
Manchester, England

Welding aluminum-alloy castings—Preheating not always necessary—Factors governing torch selection—Regulation of the flame—Rapid manipulation prevents burning—After treatment of welded joints

JIGS are extremely useful in production welding and for occasional sheet-aluminum jobs. The judicious use of jigs, often of the simplest nature, will make it possible to overcome the tendency to distortion in the finished product. This may be accomplished first, by holding the edges in the heated weld metal; second, by properly spacing the sheets and restricting the rate at which the edges come together as the weld progresses, or third; conducting some of the welding heat away from the parts of the sheet adjacent to the weld. The use of jigs in repetitive production work assures standardization in the finished products and reduces the cost by increasing the speed of welding. Before commencing to weld aluminum directly on the asbestos sheets, as referred to in the previous article, it is advisable to play the torch flame over that part of the material which will be in the vicinity of the underside of the weld, since commercial asbestos generally contains moisture and organic materials that tend to form blowholes on the underside of the welded joint. Expansion and contraction in sheet aluminum may be greatly minimized by judicious cooling away from the weld, during welding, to localize the heating. In practice, it is sometimes found that sheet aluminum that has been excessively cold worked, and not subsequently annealed, will after welding, contract to a greater extent than it expanded, oftentimes causing serious buckling or warping.

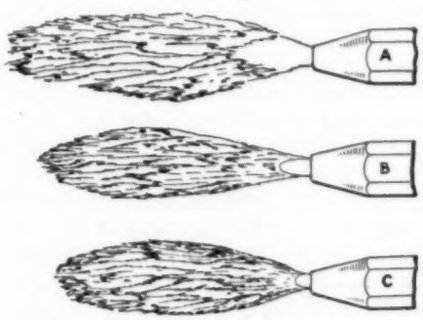


Fig. 9—Regulation of flame

In welding aluminum alloys, precautions should be taken against expansion and contraction by preheating and annealing the work effectively. The entire casting should be preheated to a temperature of 260 to 300 deg. C., or a temperature at which it will not ring when hit with a hammer. Aluminum does not change color quickly with increase of temperature, consequently there is practically no visible warning of overheating. The writer has known many instances where aluminum-alloy castings have been totally ruined, owing to their having collapsed through overheating. Above 400 to 450 deg. C., aluminum and its alloys become very fragile, and a repaired casting may easily be rendered useless, owing to deformation during reheating or annealing.

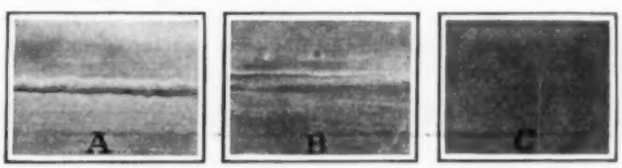


Fig. 10—Butt, flanged and hammered-flanged welds

It is advisable in the case of automobile oil-pumps, gear and crankcases, which are thin and often of complex shapes, to support the casting beneath the fracture or joint with sheet iron or steel bent to fit the interior, and covered with sheet asbestos. The sheet metal in turn may be blocked up with suitable material to provide the needed support.

Many aluminum parts can be welded successfully without preheating, such as lugs or projecting pieces that have been broken off completely—that is where a loose piece is to be welded on one end only, or where surface sand-holes, defective flanges, worn surfaces, etc., are to be filled or built up. Many contrivances are in use for preheating, annealing, and maintaining the necessary heat during welding, also various designs of furnaces and ovens are often employed, using wood charcoal or charcoal mixed with coke. Gas, or oil burners and the welding torch also may be used in preheating the castings to be welded. The heat should be applied to those parts that will be stressed most by local expansion, and means should be provided to conserve the

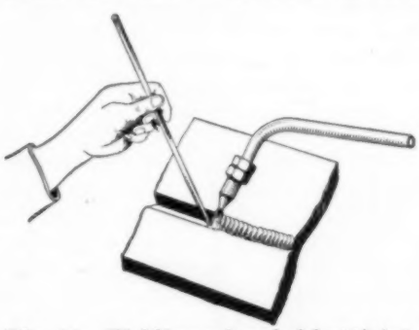


Fig. 11—Welding a beveled buttjoint, using welding rod

Conclusion. The first part of this article was published on page 275.

heat and prevent waste of fuel. In many automobile shops, it is customary to build temporary brick furnaces around aluminum-alloy castings to be preheated, so as to confine the flames and direct them where the heat is required.

There are many things to be considered in selecting a welding torch to use in autogenously welding aluminum and its alloys. Good welds can be obtained only if the torch will constantly maintain a neutral flame; therefore, the torch must be designed and constructed so that oxygen and acetylene will be delivered at constant pressures and in constant volumes. The best torch for all around shop use should be sturdy in design, thus even if misused it will not be easily damaged. The material from which the torch is made should be of the highest quality so its life will be as long as possible. For production work on aluminum sheets, the torch should be light and compact, so it can be handled continuously for hours without unduly tiring the welder.

The best torches are so designed that they will do the work required of them with a minimum consumption of oxygen and acetylene. One of the best torches, in addition to the usual needle valves, has an additional mechanism for flame adjustment. A very fine regulation of the flame contributes materially toward securing good welds at a minimum of time and gas consumption. Such an arrangement also makes it easier to control the metal under the welding flame—a matter of extreme importance in welding aluminum sheets.

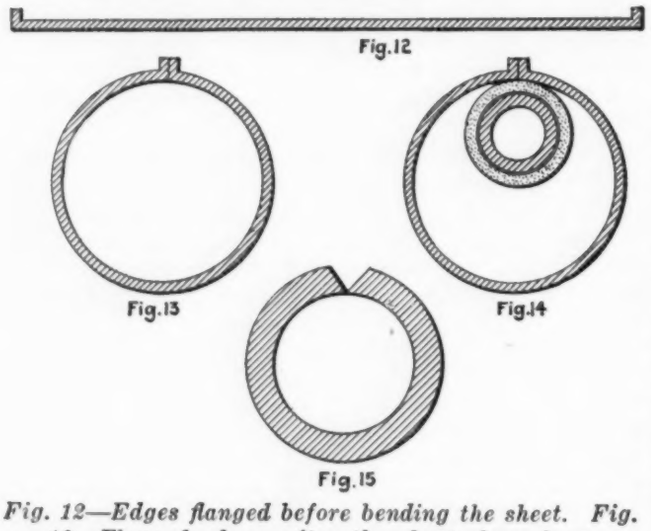


Fig. 12—Edges flanged before bending the sheet. Fig. 13—Flanged edges, after the sheets have been bent. Fig. 14—Use of mandrel covered with asbestos. Fig. 15—Beveled joint on thick pipe

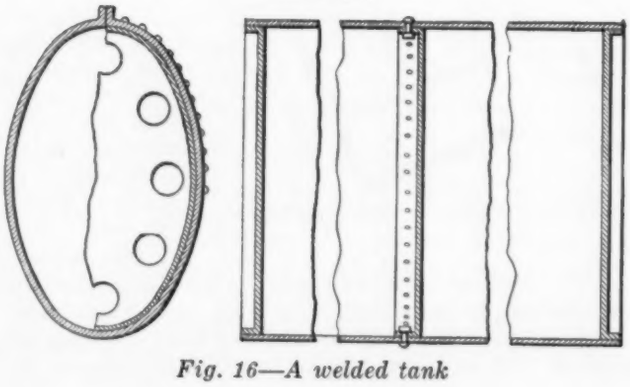


Fig. 16—A welded tank

Modern torches are usually constructed with interchangeable tips of graduated sizes, for welding metals $\frac{1}{32}$ in. in thickness and upwards, so that almost any thickness of metal may be welded with one torch. Torches with interchangeable tips are preferable in repairing, castings of alloy, but for repetition work on aluminum sheets the fixed-power torch has advantages. It is important to use a torch of the right power. The size or power of a torch is denoted by the number of cubic feet, or liters, of acetylene burnt per hour when the flame is correctly adjusted or regulated. This quantity usually is marked on the torch or can be obtained from data supplied by the maker. Table III gives the figures for a few thicknesses of aluminum to be welded and the approximate powers of the torch to be used.

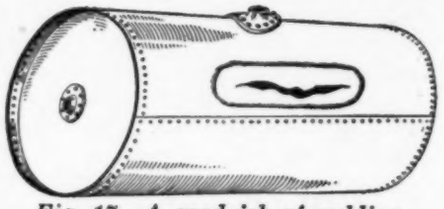


Fig. 17—A good job of welding

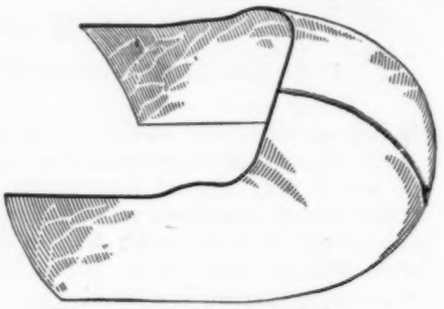


Fig. 18—Welded panel for an automobile

Oxyacetylene welding of aluminum sheets is generally a manufacturing proposition, sheet aluminum being extensively used in automobile and aircraft construction, railway, chemical, brewing industries, and for household and cooking utensils.

In the actual operation of welding sheet aluminum, the torch flame must be carefully regulated and the correct adjustment of the gases maintained. The proper adjustment is secured when a slight excess of acetylene appears. Sheet aluminum, while it oxidizes readily under an excess oxygen flame, is not injured by a flame containing a slight excess of acetylene. An excess of acetylene, giving a long flame, with an extended tip on the small cone, is shown in Fig. 9 at *A*. *B* illustrates the normal or correct welding flame, while *C* indicates too much oxygen, which shortens the flame and changes its color. A little experience will enable the welding operator to obtain accurate adjustment of the flame to suit any particular welding job. Some little increase in the flow of acetylene becomes essential after using a torch continuously, since the heat causes expansion of the acetylene.

The torch flame should be inclined at an angle of about 60 deg. to the plane of the weld, and its motion should be away from the welder—not toward him, since this gives him greater facility for observation in making the weld. It is most essential that the tip of the white cone must not come in contact with the metal about to be melted, because the high temperature of this part of the flame tends to produce holes in the metal that are difficult to mend. The distance of the tip of the white cone from the surface of the metal will depend upon the power of the torch and the thickness of the metal, and will vary between $\frac{1}{16}$ and $\frac{3}{4}$ in. in most cases.

In executing the weld (where the metal is not flanged)

the welding material and the surfaces to be joined must be melted simultaneously, and on no account should the filling material be allowed to fall in globules upon the work. On aluminum sheets or plates $\frac{1}{16}$ in. or more in thickness, one end of the welding rod should be constantly submerged in the molten metal in the welding groove. It will be observed that the first fusion of the metal takes some time, owing to loss of heat by conductivity, and on this account the rate of welding will increase as the work or edges gradually become heated.

By judicious and rapid movement of the torch flame, the welder can completely prevent burning, and at the same time effect a homogeneous joint. All welds on sheet aluminum should be expeditiously executed from the moment the first fusion is obtained. The rate of travel should be fast and uniform, and should gradually increase as the weld proceeds. Tardiness or stopping in the middle of a job is generally fatal. The speed at which welding can be done on sheet aluminum, depends largely on the nature of the job and the skill of the operator. As an example, an approximate rate at which welding can be executed on aluminum sheets, say, $\frac{1}{16}$ in. thick, in a straight-ahead job, is from 35 to 45 lineal ft. per hr., whereas in vertical or irregular welding, 10 to 20 lineal ft. per hr. is considered to be a good average.

Vertical welds on sheet aluminum are often required and can readily be made, but only by expert operators. Some operators commence at the bottom of the weld and work upwards, while others reverse this procedure. One advantage of commencing at the top is that the heated welding flux flows ahead of the flame and prepares the metal, whereas if the welding is done in an upward direction, the flux has to be frequently applied, since it is impossible for it to run upwards. A paste flux is advantageous in vertical welding.

After the welding operation, the metal should be allowed to cool slowly, and when sufficiently cold, the welded joint and its immediate neighborhood should be thoroughly washed with clean hot water. The washing is to remove all traces of the flux, which would otherwise continue to have a chemical action on the aluminum, thereby setting up corrosion of the metal.

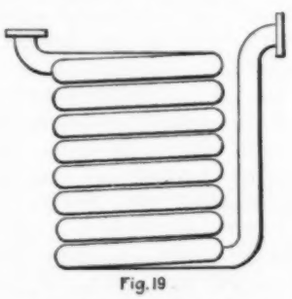


Fig. 19

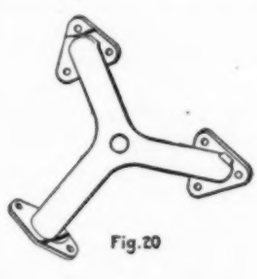


Fig. 20

Fig. 19—Aluminum flanges welded on coil of copper pipe. Fig. 20—Broken flanges repaired by welding

The writer has seen many cases of injury to the surface of sheet aluminum caused by incomplete removal of the remains of the welding flux. Although apparently so small a point, it has been thought well to lay stress upon it.

The strength of the weld or joint will be considerably improved by after treatment, consisting in hammering lightly over the area of the weld and finally annealing. The annealing temperature is from 350 to 400 deg. C., which is roughly the temperature at which a stick of dry wood will just char when rubbed on the surface of the metal. This fact is useful when a very large sheet is to be annealed, when the annealing may be done with a coal-gas, gasoline or kerosene blowlamp and continued until a matchstick will char when rubbed on the surface, after which the sheet should be allowed to cool.

Table III—Power of Blowpipe for Aluminum Welding

Thickness of Weld	Thickness of Weld	Delivery of the Blowpipe Acetylene per Hour Litres	Cubic Feet
Under $\frac{1}{32}$ in.	.....	25	0.89
0.03125 or $\frac{1}{32}$ in.	0.7937	50	1.75
0.046875 or $\frac{3}{64}$ in.	1.190	75	2.65
0.0625 or $\frac{1}{16}$ in.	1.587	100	3.5
0.09375 or $\frac{3}{32}$ in.	2.381	150	5.25
0.125 or $\frac{1}{8}$ in.	3.175	250	8.83
0.1875 or $\frac{3}{16}$ in.	4.762	500	17.5
0.250 or $\frac{1}{4}$ in.	6.350	750	26.25

The beginner will find the best results can be obtained by using a slightly less powerful blowpipe, whereas the more expert welder can use a more powerful one.

When annealing repetitive work, it is advisable to use a gas-fired muffle, or use may be made of large ovens similar to core ovens. In such cases, however, it is almost essential to employ a pyrometer to indicate the annealing temperature, otherwise there is a real danger that the work will be overheated and ruined. Correct annealing has the effect of re-arranging the molecules of the metal, and results in homogeneity throughout the weld.

Sound welds in sheet aluminum possess a degree of strength only slightly below that of the original section, and by judicious re-inforcing, or building up, the strength can be increased so as to be equal to that of the original metal. The welds or joints, when properly made, present a neat and finished appearance. They are sound and homogeneous in structure, and, as shown at *C* Fig. 10, are practically invisible from every standpoint.

The tools for hammering and smoothing operations must be smooth and clean, or the surface of the metal will be injured. Care must also be taken not to scar the surface by striking with the edge of the hammer. Many light hammer blows will be found to be more preferable than a few heavy ones, as the latter are likely to stretch the metal too greatly. On production work, hand hammering may be advantageously replaced by the use of a power-driven hammer delivering some hundreds of blows per minute.

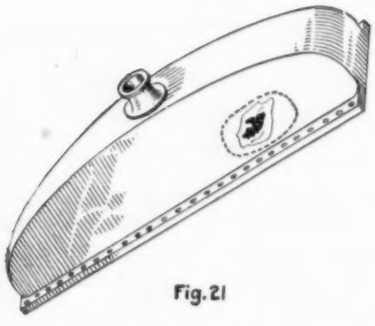
The successful welding of aluminum alloys depends very largely upon the successful breaking down of the layer of oxide which is intensified at welding temperatures, and it is this refractory layer of oxide which prevents a proper flow of the metal.

When a new piece of metal is to be welded between the edges of a fracture or break, it is desirable that that new metal should have the same chemical composition and physical properties as the rest of the casting. In repair shops it is oftentimes an economical proposition to utilize parts from old scrap aluminum-alloy castings that will produce satisfactorily a replica of a missing part.

In the photographic reproduction Fig. 10, at *A* is shown a good buttweld on sheet aluminum 0.048 in.

thick, while *B* represents a good flanged weld on a sheet 0.022 in. thick, and *C*, a hammered-flanged weld that is practically invisible. Fig. 11 illustrates the progress or method of welding a beveled joint with welding rod. Fig. 12 shows the edges of a longitudinal seam, flanged before forming the sheet to a circular shape. In Fig. 13 are shown the edges formed for welding on the outside of a cylindrical section. Fig. 14 illustrates a cast-iron mandrel coated with asbestos sheeting, which is advantageous to place under the joint when welding cylindrical and elliptical sections.

In Fig. 15 is shown a beveled joint on a thick section of aluminum pipe. In Fig. 16 are shown the end and side sections of automobile tanks fabricated by autogenous welding. The longitudinal and end joints are flanged preparatory to welding. The baffle plate is riveted in position, since it would be somewhat difficult to weld it satisfactorily on the inside of the tank, owing to insufficient space. The rivets are made a lasting



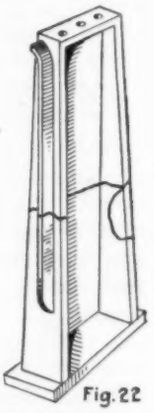


Fig. 21—Damaged radiator tank. Fig. 22—Broken radiator-standard

job by directing the torch flame vertically on each rivet head, melting it and fusing it with welding material. Fig. 17 illustrates a good welding repair job on a badly-damaged vacuum reservoir, 0.128 in. thick, and having riveted joints.

It was necessary to cut the fractured portion of the reservoir away, thereby forming an oval-shaped opening. An oval-shaped piece of sheet aluminum, 0.128 in. thick, was cut to fit very closely to the edges on the vessel. It was then slightly beveled, and tacked in position before welding around the edges. Fig. 18 shows a back panel for an automobile body, made in halves and welded together in the center. As previously mentioned, a welded joint of this type on sheet aluminum, when properly performed and afterward hammered, is practically invisible.

A seamless condenser coil of aluminum piping with flanges of cast aluminum autogenously welded, is shown in Fig. 19, while in Fig. 20 is shown a pipe or manifold with fractured flanges. Fig. 21 illustrates a damaged radiator tank. A new piece of aluminum alloy (see dotted lines) was prepared and fitted closely to the opening in the radiator casting and welded in position. Fig. 22 illustrates a side standard of a radiator, completely broken in two parts, also a fracture at the side, that was repaired successfully by oxyacetylene welding.

We frequently ask for criticism and then resent it when it is not all favorable. But adverse criticism is frequently the more valuable—if we profit by it.

Seen and Heard

By John R. Godfrey

Girls handling cranes

WE'VE changed what passes for our minds about a lot of things since the war, one of them being the handling of cranes by girls. We men have always kidded ourselves into believing that it took the calm and keen judgment of a masculine mind to handle a crane dependably. And most of us would have kept at a safe distance when a girl was in charge of the cage in any crane.

But if there's one job more than another in the shop where girls have made good, it's handling cranes, both big and little. I recall the cranes that served the shrinking pits of a large shop building 155-mm. guns. It's no fool-of-a-job lifting the red-hot jacket of a long gun out of a furnace, carrying it to the gun pit and lowering it over the gun. With only a few thousandths of shrinkage allowance and the deuce to pay if the jacket isn't lowered straight and steady enough to slip over the gun, it is a test of both skill in crane handling and coolness of judgment.

The first time a girl was tried on this crane there were many misgivings and much wabbling of the knees, but the job was done to perfection. It was soon found that this wasn't a fluke, that girls seemed to have the right sort of temperament, or capacity, or whatever you may call it, to handle this kind of work both carefully and efficiency. As a result this shop hasn't had a man on a crane since the war.

Whether the news came from this shop or whether other managers tried it out for themselves, the idea spread until we find girls running cranes in shops of many kinds. One big railroad shop I know of, has a girl operator who handles anything from a batch of boiler flues to a complete locomotive. And the men have as much confidence in the success of the operation as they did under masculine control.

Not long ago, I saw several special hoists and cranes handled by what is known as "remote control." The girls were in a cage, in one case, and controlled both the travel and hoisting functions of a number of monorail cranes by push buttons. The way in which the girls handled these cranes would be a joy to any motion-study artist. Controlling two cranes on different operations, and the co-ordination necessary to bring different parts together at the right time and place, made as pretty a piece of work as I have seen for many moons. When it comes to work of this kind, we can no longer call it a "man's job." And it is just possible that the girls are fully as happy as when washing dishes, or scrubbing floors, which used to be considered as their suitable occupations.

I never could see why every girl should be expected to like house work, though it's a good thing some of them do. But they are not all made in the same mold any more than are men, all of whom do not like to milk cows or toot a saxaphone.

Conveying machinery, carefully planned and installed, has far more effect on inventory than many imagine. Good conveying systems also enable the rate of output to be changed at short notice, making a plant more flexible to meet changing market conditions.

Modern Tooling Methods for Turret Lathes

By M. E. Lange
Production Engineer, The Warner & Swasey Co.

Better methods of chucking work—Increasing production by combined cuts, multiple cuts, and rigid tooling—Various types of chucks—Attachments and fixtures for chucks

STANDARD chucks for universal use should have removable, stepped jaws so that they can be quickly reversed for internal or external gripping, as in Figs. 99 and 100, and so that either soft or special jaws can be fitted as well. Adjustable back stops or wire stops rings often make special jaws unnecessary.

For tight gripping on rough surfaces, soft jaws are often shaped to the work, as in Figs. 101 and 102, and then hardened or corrugated. If the work to be done is extremeely severe, or if the gripping surface is a difficult one, hardened drive pins may be inserted in the jaw as shown in Fig. 102, and replaced when worn.

The loading plug shown in Fig. 103 is fastened to the hexagon turret and used to center the work at the free end when tightening the chuck. Another type of loading plug may be used for guiding the work into position in the chuck. With very heavy work it is often convenient to mount the work on the loading plug, while it is pointing toward the front of the machine, and then swing into position for loading into the chuck.

A chuck with soft jaws, as in Fig. 104, is the cheapest type for gripping on previously finished surfaces for second-operation work. After mounting, soft jaws must be bored true while they are clamped against a thin ring or disk, with about the same pressure finally used on the work. This method assures true chucking.

The adjustable back stops shown are very accurate for close limits on shoulder distances, such as in the illustration, when faced after mounting on the chuck.

A floating scroll chuck, Fig. 105, locates the work from an accurately bored diameter, and grips on the outside diameter for driving purposes only. The locating diameter of the scroll has been machined so that it can have at least ⅛-in. float in the chuck body. An accurately-centered plug is mounted in the chuck for locating the work, and the jaws will then adjust themselves to the outside diameter.

In a chuck for long work, solid jaws can be anchored directly into the guides, as in Fig. 106. Such jaws are used where the cut is started at a point away from the chuck, a distance more than one-half the chuck's diameter. On long work the strain on the screws of removable jaws sometimes causes the heads to snap.

A modification of the solid jaw is shown in Fig. 107. Here the back of the work is located by the jaw, while the free end is located truly by the loading plug and then gripped with setscrews. This type is very rigid for long, irregular work and is not too costly.

Another modification of the solid jaw is shown in Fig. 108. Here, rocking jaws are used on long work where only slight variations in diameter have to be compensated for. Such jaws are more expensive than are jaws of the setscrew type. However, work can be loaded much faster, and hence they are used mostly on work of long runs. One rocking and two solid jaws are used together.

The modifications that can be made in chucks of standard type, are many. Attachments can also be applied to suit work of various kinds. For the general run of brass work, however, the old two-jawed box chuck, fitted with adapters and special false jaws, still holds its own

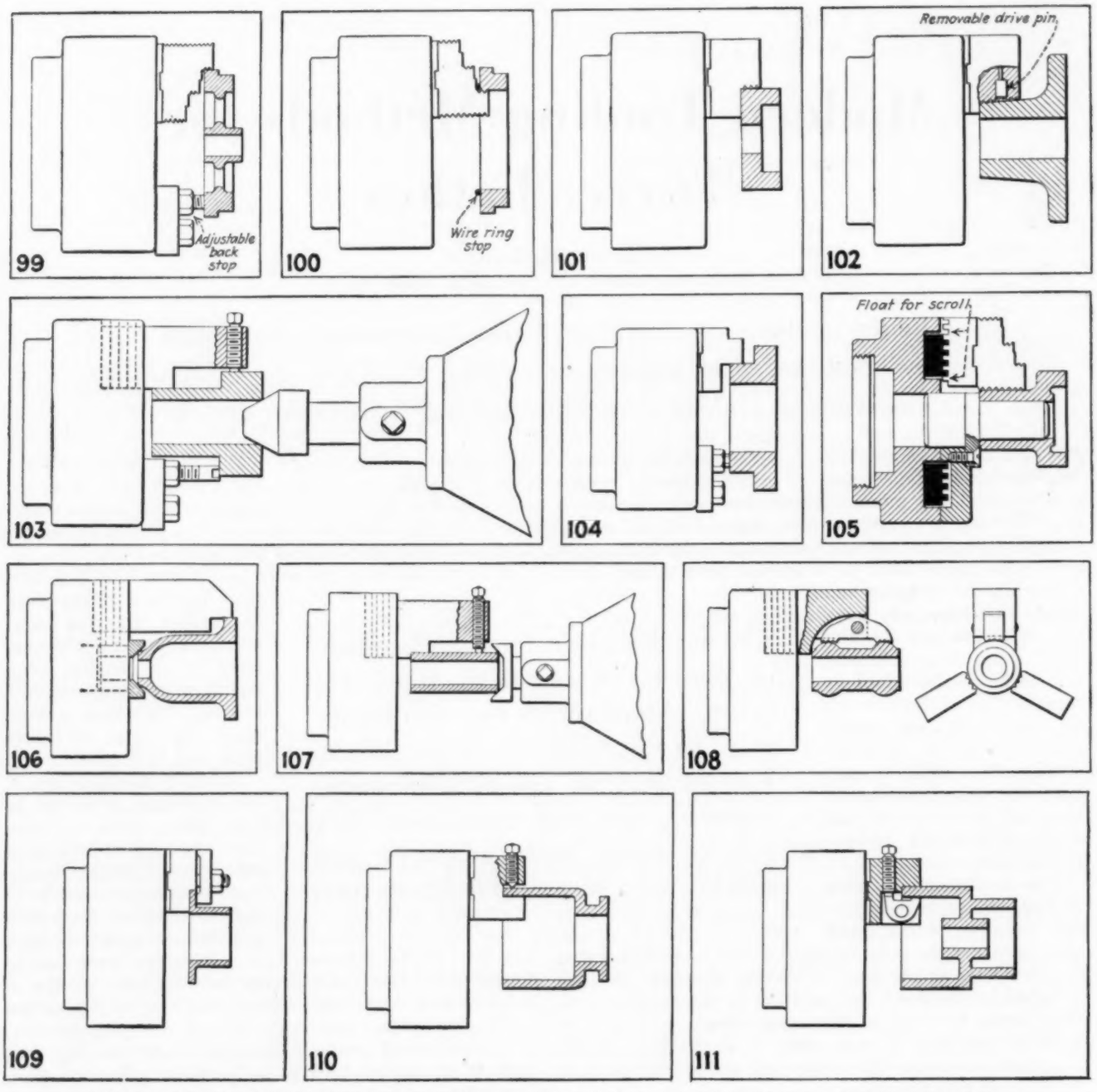
To hold frail work of the type shown in Fig. 109, and at the same time make possible heavy feeds, a jaw with a top clamp is often used to avoid distortion. The piece is first trued in the chuck by light pressure of the jaws. Then the flange is pinched with the top clamp to give driving power. In this way the work is held tightly without distortion.

With type of jaw shown in Fig. 110, the work is chucked true with the inside, and a set of screws gives driving power without springing. The screws grip on the outside, unfinished portion of the work where they can do no damage.

Another method for chucking frail work, is to grip the piece on the outside and pinch it internally, using a rocker clamp operated by a setscrew, as shown in Fig. 111. This method is often used, for instance, in the second chucking, to locate from an outside surface that has been previously finished.

The very heavy and rigid pot fixture, shown in Fig. 112, is used to hold various sizes of large pump cylinders in taking heavy cuts. Setscrews at the forward end bear against swinging jaws, which in turn bear on

The sixth article. The seventh will appear in an early issue.



Figs. 99 to 102—Chucks for first operations. Figs. 103 to 105—Chucks for second operations Figs. 106 to 108—Chuck jaws for long work. Figs. 109 to 111—Chuck jaws for frail work

top of the ribs of the work. The loading plug *A* is mounted on the standard slide tool.

In using the pot fixture shown in Fig. 113, one end of the work is gripped internally by the jaws of a standard chuck, and is steadied on the outer end by setscrews. This fixture is inexpensive, since a standard chuck is used as a base. The weight of the pot and the work is counterbalanced by the weight *B*, attached to the chuck body.

The inexpensive angle fixture shown in Fig. 114, is bolted to a standard faceplate, and the work is held with ordinary setscrews and clamps. The work is located from a previously-finished flat surface. This fixture is well suited for small lot production, because it establishes accuracy at a small cost.

The large, balanced, drum fixture, illustrated in Fig. 115, is made heavy to avoid springing. It is also well balanced to permit running at a sufficiently high rate to get the proper cutting speed. The fixture is adjustable for holding as many as six various sizes of pillow blocks.

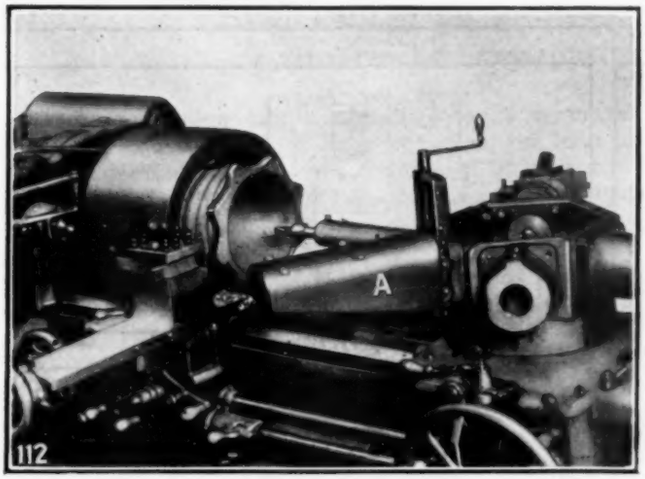
The faceplate fixture shown in Fig. 116 is used to hold such work as starter housings. The central locating plug insures concentricity and the clamps have sufficient body to drive without slipping. A driver may often be added to this type of fixture, if the work has a suitable rib or projection, making it possible to use greater feeds.

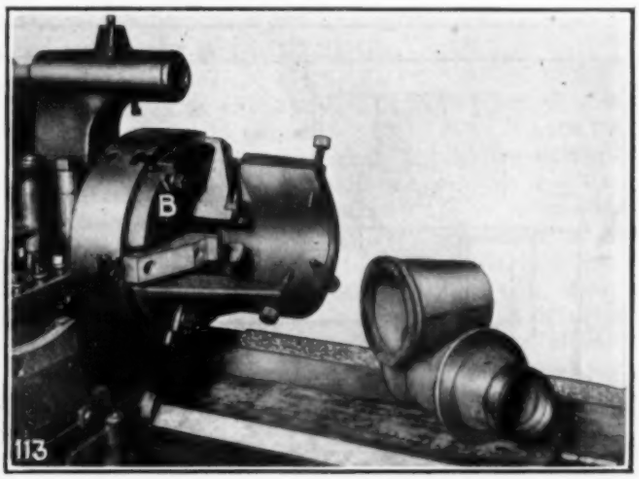
The indexing fixture shown in Fig. 117 indexes the chuck in two positions. A cam is used to throw it in either direction, and the nuts on the back plate lock it in place. The fixture has adjustable index points and gives great accuracy in boring two holes that must be accurately located in relation to each other. A standard

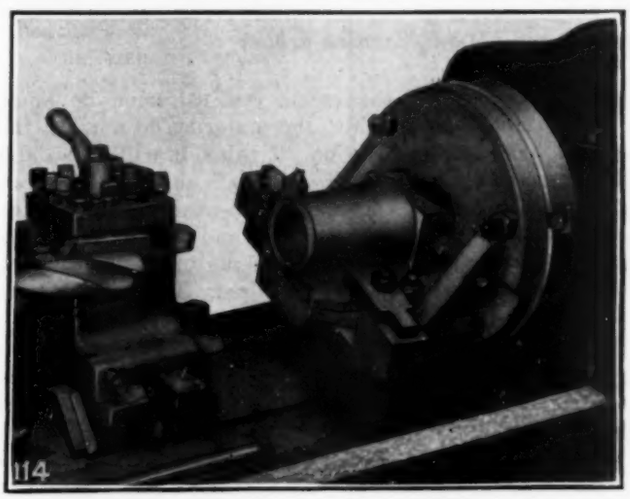
three-jaw chuck is used for gripping the work piece.

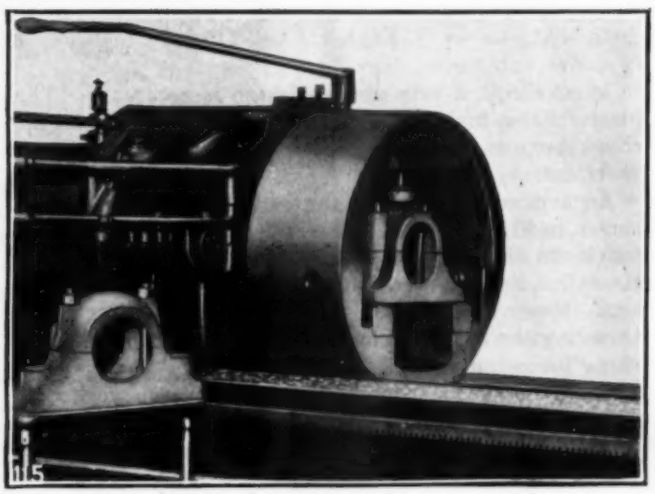
Much of the smaller work of irregular shape found especially in the brass shops, is difficult to chuck accurately and quickly without the use of jaws that are fitted to the shape of the work. The two-jaw chuck, Figs. 118 and 119, is well suited for this work because its coarse pitch, double-ended screw makes it possible to open the jaws quickly for loading the work. False jaws are generally made of cast iron and are finished to fit the contour of the work. They are attached to the master jaw with an adapter which should be made to suit the standard of the shop, such as the common dovetail or other shapes.

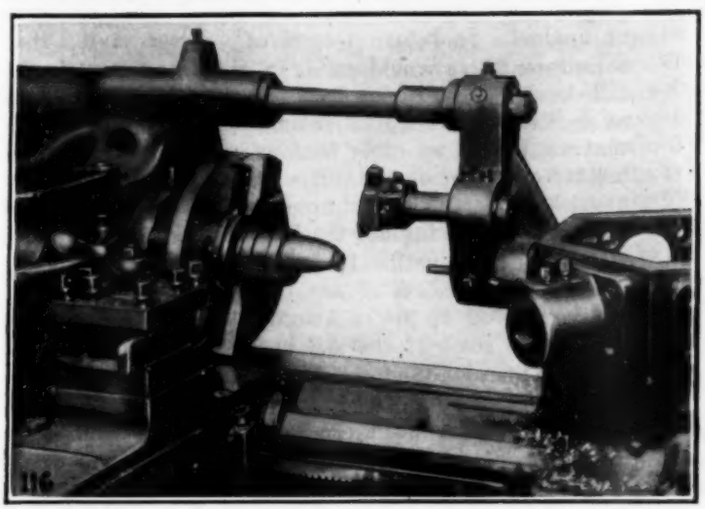
Brass must be run at high speeds, and in order to quickly start and stop the machine, the revolving weight of the chuck must be kept at a minimum. Hence it is advisable to use a rectangular rather than a round shape. Due to the hard use box chucks are subjected to

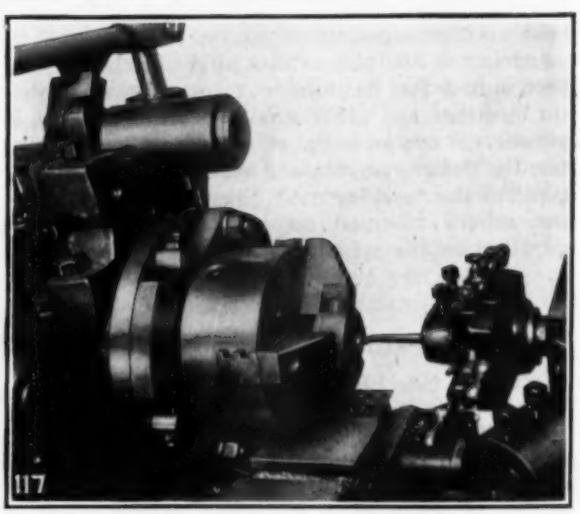




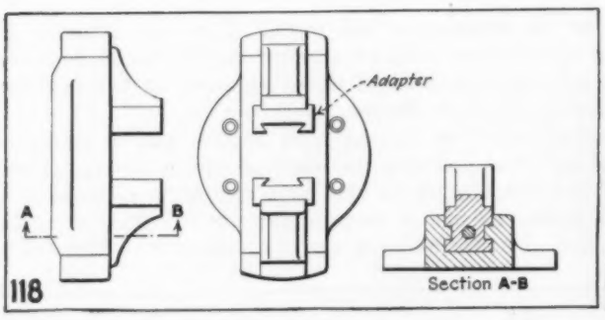


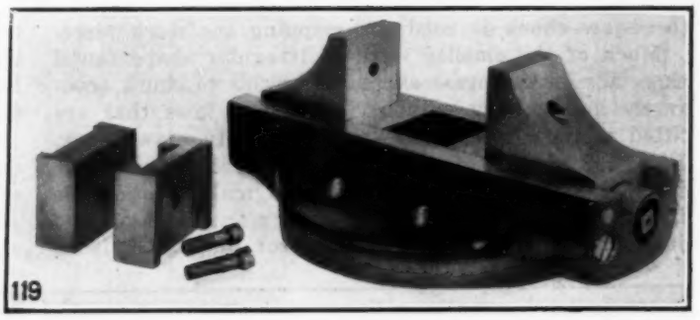


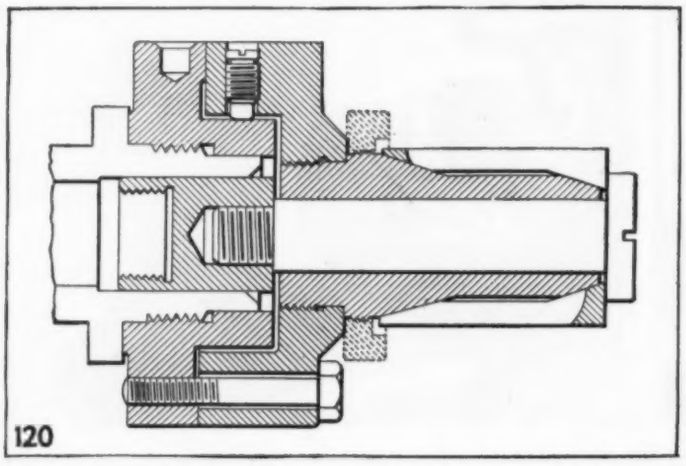


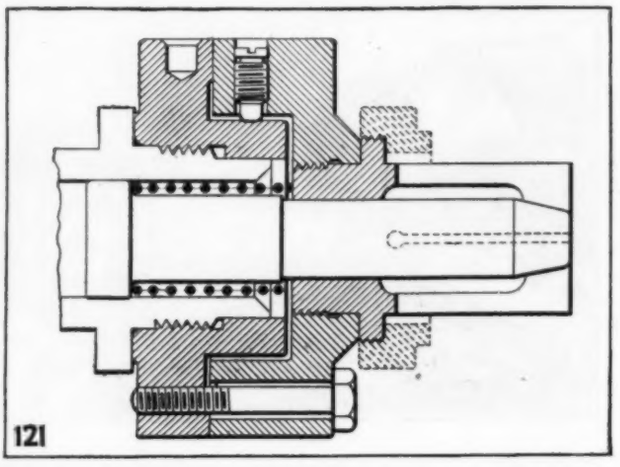


Figs. 112 and 113—Pot fixtures. Figs. 114 and 115—Angle fixtures. Figs. 116 and 117—Miscellaneous fixtures









Figs. 118 and 119—Box chucks. Figs. 120 and 121—Expanding arbors

in brass shops, a very sturdy design is necessary. The master jaws must be well and deeply anchored in the chuck body to prevent their becoming inaccurate at an early date.

An expanding arbor of the expanding bushing type, shown in Fig. 120, is best used for roughing work where maximum driving power is needed. The work is gripped its entire length, even when the holes vary slightly in size. However, there is danger in this type of arbor of throwing the split bushing out of true, because of brass chips becoming frozen fast onto the solid center stud. This type of arbor cannot be relied upon for work that must be absolutely concentric.

An expanding arbor of the type shown in Fig. 121 will produce very concentric work. The gripping power, however, is considerably less than that of the expanding bushing type, since the expansion is entirely at the forward end of the plug. This kind of arbor is therefore best suited for finishing cuts on very accurate work. On bushings and other small, accurate work, it is good practice to use an arbor of the expanding-bushing type for the roughing cut, and one of the expanding-plug type for the finishing cut. Figs. 120 and 121 both show the arbors mounted on adapter hoods that can be adjusted on the spindle.

Do Salesmen Know Their Product?

BY CHAS. W. GERRY

I have been following closely the various articles, editorials and discussions on the customs and habits of machinery manufacturing companies, representative firms and salesmen of the same, until I can no longer restrain the inclination to rush into the discussion.

While it is true that some few salesmen do know their products thoroughly, the majority do not. In the past I have been fed up on, "I think it will do so and so," or "it ought to do so and so," until I have been disgusted with the amount of non-essential knowledge that some of the firms give out and which representative houses and salesmen expect us to swallow before we recommend that line of machinery or other goods to the purchasing agent.

As an example: A salesman of steel called at the shop to interest us in his product. We had received some very hard steel castings and some cast-iron castings that seemed to be chilled. I had read of the excellent qualities of a certain steel and had written for information and samples, heat-treated for our purpose, giving explicit explanations of what we were up against. In return I received a letter saying that a representative would call. In about three weeks he called, armed with our letter but without any data as to heat treatment, without samples or knowledge that would help us, other than as given out in circulars handed out in profusion. His vague "Why, I think the usual heat-treatment that you give any high-speed steel is sufficient to bring out the best qualities of this steel, which you will notice [pointing to the folder] gives results far in excess of any other steel. Now, may I not write you up for a quantity of this steel?" He was shown some of the last batch of castings passing through the shop and the results obtained through the use of another steel. His comment was typical: "Really that steel is punk, not up to their advertisements, which are quite laughable. Can't we send you a quantity of this steel of ours?" etc. "No! You can not," was the very short answer, and thereupon we established a fine reputation as a grouch.

Choosing Your Business Partners

By E. W. Leach

Reasons for care in choosing partners—Pitfalls in the path of the business man—The character of the partner—The new partner and the old organization

IF I were going into business tomorrow to manufacture some article of my own design, the least of my worries would be the problem of raising sufficient money to get started. I am thinking of plans that would require initial financing of perhaps from five to twenty-five thousand dollars.

It is very seldom under these conditions that one incorporates a company and sells common stock promiscuously to the general public There are several reasons for not doing this. One reason is that the business is unquestionably speculative, and most states now have commissions that pass upon requests for stock selling licenses and look with disfavor upon the stocks of newly organized concerns.

The general public is more often called upon to respond to expansion requirements of well-established manufacturers, rather than to the original demands of some man who believes he has conceived a product that can be marketed profitably. So the increasing conservatism of an educated public, brought about by years of oil and mining swindles, operates against the man who wants money so that he can get into business for himself.

There is a good reason of my own, too, why I should not care to go to the public for money and give a miscellaneous group of total strangers a voice (more likely the control) in the management of my business. It is that if I am staking my entire business future on the successful manufacture of whatever I have invented, I want to know who else is going to have something to say about the producing and marketing of my product. In other words, I want to be very careful in choosing my business partners.

Primarily it is the money itself that you will be seeking. But of far greater importance is the man or men from whom you secure the money. As a means of buying equipment or of meeting payrolls, a dollar is a dollar regardless of where it comes from. But if that dollar orginally purchased an interest in the ownership of your business and if it has a right to demand a share of your profits, then pay some attention to its donor.

There is one question to be settled at the very start. Do you want the man who furnishes the money to become active in the company? Well, like all other questions, there are two sides to this one. No one man can "do it all" in a manufacturing business unless he plans to be forever content with a "one man business."

Inventors and designers are very apt to be one-sided people. They often discount the importance of the selling or merchandising end of the business. There is no such thing as a product that sells itself. Everything requires trained salesmanship behind it to put it into consumption and distribution. The closer a product comes to being an absolute necessity, the keener competition it will have to bump up against. Sales and advertising ability are always needed in a new business to meet competition if a necessity is being promoted, or to show people their need for what you make if it is a luxury.

WHEN you plan to develop your business or to market your invention study the hand that offers you the necessary capital. Investigate its character and its past history. If the man to whom it belongs can satisfy your code of ethics and will fit into the spot in your organization that needs filling, you may have confidence in your future partnership. If you limit your watchfulness to the dollar that you need you may be getting more than you "bargained for."

The ideal manufacturing business is one where some one man is responsible for production, and some one man is responsible for distribution. We all fit naturally into one of these two positions by reason of our very aptitude for a certain kind of work. The best thing for the mechanically inclined man is to "stick to his last" as the shoemaker does and to try to locate some other man who is capable of taking full charge of the sale of the product and who can invest the required capital in the business.

Next best, of course, is to employ a sales manager on a straight salary, and to be financed by some prosperous business man who is content to be, in a certain sense, a "silent partner."

I have seen many deserving businesses hit the rocks during the first stages of their voyages, simply because a man who needed money for financing grabbed at the first check that was offered him. So I just cannot overemphasize the importance of investigating the personal character of your prospective partner even more rigidly and impartially than the balance that backs up his bank account.

I think of one instance where a man had invented a piece of equipment for home heating plants. He started to sell the device for $45, which was a fair price for it. He was approached by men who wanted to help him to "do something big." They incorporated, opened costly display rooms in the heart of the retail district and employed a crew of salesmen. The price was raised

at once to $60, then to $75, and for a short time to $90. Sales dropped practically to zero and there was no money coming in.

Salesmen left because their commissions were not paid to them. Executive salaries were passed up repeatedly. The men who had put up the money had other sources of income and so did not worry. The man who had started the business, however, "stood the gaff" as long as he could, and then disposed of his holdings to his partners and stepped out minus the rights to his invention. The price was immediately reduced and sales picked up. Nothing illegal about it, no laws broken and yet men have gone to prison for much less.

Another man who had invented a complete line of equipment for a certain kind of trade shop, sold control to a group of outsiders. They got together one Sunday afternoon to complete the organization and pass out the stock certificates. The inventor of the product was elected president. A few months afterwards, when he had come through with all his bright ideas and everything had been patented in the name of the corporation, he was told that unfortunately his election on a Sunday was illegal, and that in reality he was not president at all. In fact, his associates found that they were not in accord with his methods of management and consequently they were removing him from the payroll. It would seem that there should be some legal redress for such actions, but in the language of today "try and get it."

Preferred Stock Wins

A third man who appeared satisfied with his choice of partners found that the business needed another two or three thousand dollars. It was suggested that each member put up money in proportion to his present holdings of stock. The man who had furnished the product was not in a position to do that; so the outside partners agreed to supply the necessary cash. Out of fairness to the active partner, however (so they said), and so that they would not destroy the existing division of ownership, they said they would be willing to receive preferred stock for the additional money. The business did not prosper and it was finally closed up. The men who held preferred stock had first call on the proceeds of sale. As a result, the men who would suffer the least got all the proceeds, and one man who depended on the business for a "job" got nothing and lost the patent rights to his inventions.

I know of two men who make a business of buying up bankrupt companies and reselling them to the original owners. On the surface of it it doesn't sound so bad but let me explain the process in detail. A manufacturer is in pretty deep at his bank. He is approached by these men who say to him, "We understand you have some heavy obligations at your bank that are preventing you from running your business efficiently. If you care to file a voluntary petition in bankruptcy, we will put in a bid for the business. In the event we are successful in getting it, we will sell it back to you at a profit to us of 10 per cent of what we have to pay for it."

Imagine getting out from under ten or fifteen thousand dollars worth of loans (to say nothing of all the accounts payable that are probably badly past due) for three or four thousand dollars. To one who has no business honor the plan must hold out quite an appeal. The scheme can serve equally well where a company may wish to eliminate one of the owners and it has actually been used for that very purpose.

I know these illustrations all sound crooked. According to your moral code and mine, they are. Most men who come back from Leavenworth or Atlanta will tell you they were convicted of a "technical violation of the law." It seems that the line which divided shrewd business from actual crime is rather hazy and indefinite. In many cases, if one were in a position to prosecute one's claim and fight the thing through to a finish, there would be proper retribution.

But when you are dealing with men who have lots of money and when you are faced with the necessity of getting another position without any interruption of income, about the only thing to do is to tighten up your belt and start anew somewhere else.

Most men are actuated by high motives and want to be honest and fair in business. Most companies are quite free from the dangers of such injustices as I have told you about. The reason is that most men judge each other by their character and not by their income tax.

If you are going to go into business for yourself you have got to have money—about twice as much as you at first believe you need. By all means investigate with absolute impartiality the men who offer their money to you. Look up their present business connections, their past records, their church affiliations, their clubs, their fraternal orders. What do their employees say about them? What is their home life? Are they contentedly married? Do they take an interest in civic affairs? Have they a wide circle of business friends?

These are the things that really count. Unless you can satisfy yourself in answering such questions, it is far better that you exercise a little patience and seek further rather than to lose what little you have in an unhappy experience with men who did not measure up to your own high standard of character.

Is Engineering Education Too Technical?—Discussion

By B. Carroll

On page 1060, Vol. 63, of the *American Machinist*, there is an editorial, "Is Engineering Education Too Technical?"

This editorial seems to be confined to mechanical engineering and the like. When industrial engineering is considered, however, the question is whether the latter is technical *enough?* While technical engineering is the art and science by which mechanical properties of matter are utilized in structures and machines, industrial engineering covers economics, accounting, organization, personnel, employment, etc., but does not take in any subject which may be considered truly technical.

The editorial states that there are subjects given which are of value as mind trainers but of very little use in practical engineering. Should any of these minor technical subjects be dropped for a major non-technical subject?

The fact remains that engineers should be well versed in every phase of their art, whether of seeming importance or not. If they are to be better educated, an additional year at college on management subjects would increase their value to industry more in proportion than the dropping of minor subjects.

The Measurement of Cutting Temperatures

By E. G. Herbert
Director, Edward G. Herbert, Ltd.
Manchester, England

Further tests indicate that the free cutting range of metals is a temperature effect — correlation found beween the Whitaker ring, work-hardness and cutting temperatures

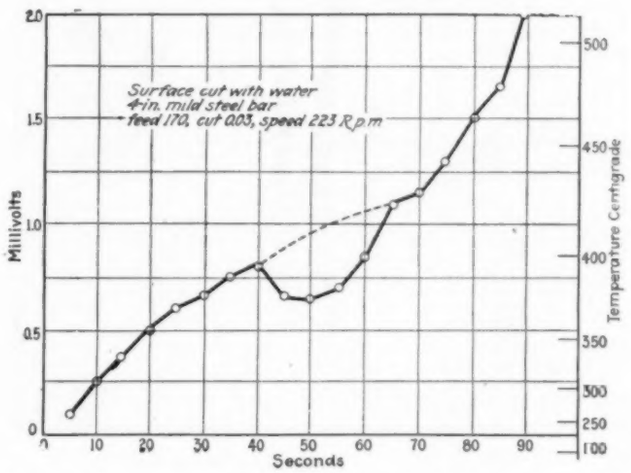


Fig. 1—Temperature rise with a surface cut from the center to the periphery of steel bar

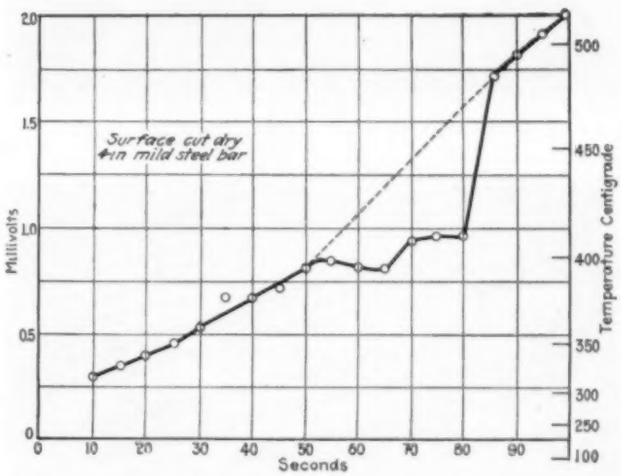


Fig. 2—Discontinuity of the temperature curve in surfacing a steel bar

IN ANOTHER section of the paper of which this is the supplement, there is a description of a method of investigation in which surfacing cuts were taken on the ends of steel bars from the center to the periphery and a record was made of the rise in temperature due to the continuous increase in the cutting speed. Many such records were made with the string galvanometer, but it was eventually found that better results could be obtained with the ordinary millivoltmeter, the procedure being to take a voltage reading every 5 sec. during the cut. The more sluggish instrument indicates general changes of voltage while it averages out the rapid fluctuations due to breaking up of the chip, vibration, and other accidental causes.

A record, such as Fig. 1, shows that when the voltage has reached a certain value it ceases to rise, in fact falls somewhat, and then rises abruptly. This test was made with a steel tool surfacing the end of a 4 in. mild steel bar. The cut started at the center and water was used as a coolant.

Only one explanation of this graph seems possible. The cutting speed and the cutting temperature increase regularly until, when the mild steel has been heated to a certain temperature, its resistance to cutting declines. After this free-cutting range of temperature has been passed the resistance of the steel suddenly increases and the cutting temperature rises abruptly.

In Fig. 2 is shown a similar result when cutting dry at a lower lathe speed. In this case the temperature ceases to rise but does not actually fall, owing to the retention of heat by the tool and the work.

The steel bar on which these tests were made is shown in Fig. 3. A striking feature is the bright ring, called a "Whitaker ring" after the worker who first drew my attention to its significance. The Whitaker ring corresponds with the depression in the voltage curves of Fig. 1 and 2 and indicates the free-cutting properties of the steel when heated by the cut to a certain range of temperatures. The phenomenon is familiar to lathe hands, but I cannot find that it has hitherto been investigated or explained. It is quite certainly a temperature effect, since the diameter of the ring can be increased or decreased at will by decreasing, or increasing, either the lathe speed or the depth of cut.

Microscopic examination shows that the ring is a freely cut, smoothly finished surface in contrast with the plucked and torn surface on either side. Fig. 4 shows the outside of the ring and the adjacent surface. The character of the chips produced from the ring and from the surrounding surfaces is shown in Fig. 5.

Supplement to a paper presented before the Institution of Mechanical Engineers, London, England, on February 19, 1926. The paper was published in the two preceding issues.

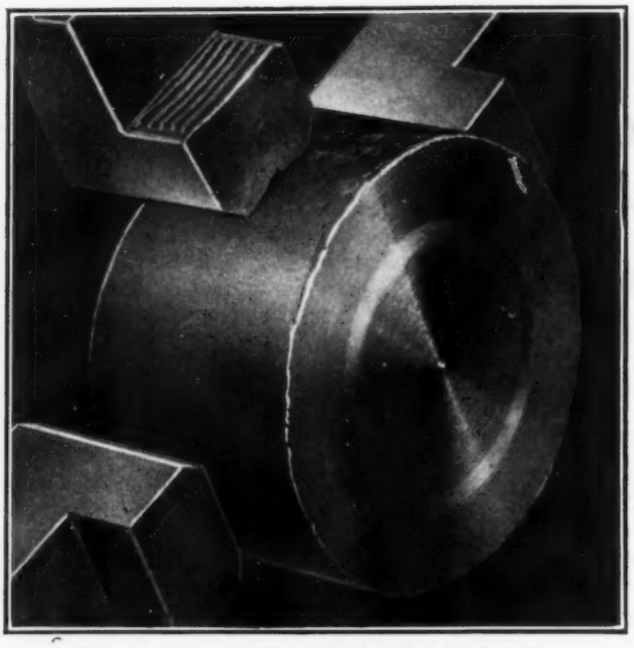


Fig. 3—Appearance of the Whitaker ring

Fig. 4—Marked contrast of the surface within and without the Whitaker ring

The explanation of the foregoing is seen in the graph of Fig. 6, which shows a series of temperature work-hardening curves made with the pendulum hardness tester on a portion of the 4 in. bar used in the cutting tests. In the work-hardening test successive scale hardness tests are made on the same spot on the specimen. Each test work-hardens the metal by rolling and the work-hardening capacity is the *increase* of hardness which can be induced in the metal by cold work. The tests were made at intervals of about 10 deg. C. in the electric furnace.

These curves show that at a range of temperatures between 100 and 150 deg. C. there is a deep depression D_2. In other words the mild steel, when deformed by a cutting tool or otherwise, does not work-harden within this range of temperatures as it does at lower or higher temperatures.

The explanation offered is as follows: The action of the cutting tool is to compress and work-harden the metal in front of it. Rupture occurs in the work-hardened metal, whose resistance to cutting depends on the degree of hardness induced in it by the tool.

The D_2 depression in the work-hardening curve coincides with the free-cutting range of temperatures. Metal cut within this range is only slightly hardened by the tool with the following results:

1. The metal cuts freely, leaving a smooth finish (Fig. 4).
2. Less heat is generated (Figs. 1 and 2).
3. A flowing helical chip is produced (Fig. 5).
4. A bright Whitaker ring is formed (Fig. 3).

These results confirm the observations of Dr. Stanton and Mr. Dempster Smith (Bulletin of the Institution of Mechanical Engineers, No. 2, 1925) that the vertical force on the tool falls to a minimum at certain cutting speeds and also at higher speeds. Dr. Stanton found that this effect disappeared when the steel was normalized.

It is to be noted that work-hardening capacity is not hardness (see the effect of temperature on hardness,

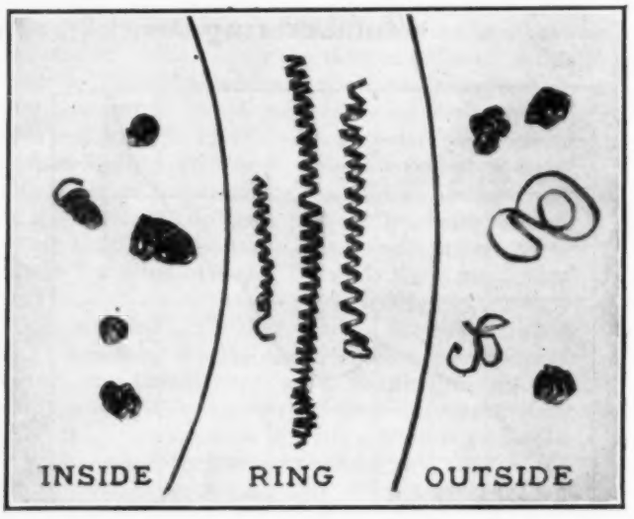


Fig. 5—Character of the chips produced within and on either side of the Whitaker ring

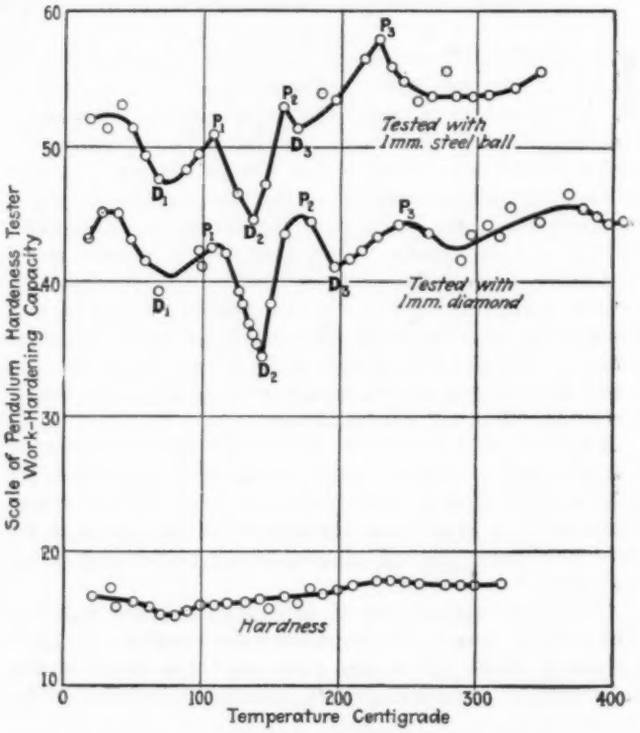


Fig. 6—Effect of temperature on the work-hardening capacity of mild steel

bottom curve in Fig. 6). The free-cutting or non-work-hardening range of temperatures was discovered two years ago with the pendulum hardness tester. It is found to occur in crystalline metals from tin to tool steel—in pure metals, alloys, and steels. The Whitaker ring was first noticed and commonly occurs in ordinary production work. It is produced with the greatest freedom and certainly with a tool on the margin between free cutting and tearing. A tool with a sharp V-nose of 80 deg., without top rake, and with one to two inches overhand has been found suitable.

The ring shown in Fig. 3 is a D_2 ring. Three rings frequently occur, corresponding to D_1, D_2, and D_3 in Fig. 6. These three depressions and the three peaks P_1, P_2, and P_3 are usually found in the temperature work-hardening curves of metals.

As the Whitaker ring can be produced by anyone having access to a lathe it is hoped that attention will be drawn to a newly discovered metallurgical phenomenon of very great practical and theoretical importance—the free-cutting or non-work-hardening range of temperatures, and the behavior of metals at these temperatures.

Effect of Lubricant on Taper Press-Fits

THE problem of making press fits has many angles, all of which are of interest to the man who is designing the parts to be pressed together and to the man responsible for results in the shop. One of the pioneer investigators of the press-fit problem in this country is John B. Thomas, for years the head of inspection work at the shops of the Westinghouse Machine Co., Pittsburgh, and still in service with the Westinghouse Electric & Manufacturing Company.

Press fits are generally made in straight holes, though slight tapers are sometimes used. Formerly, a

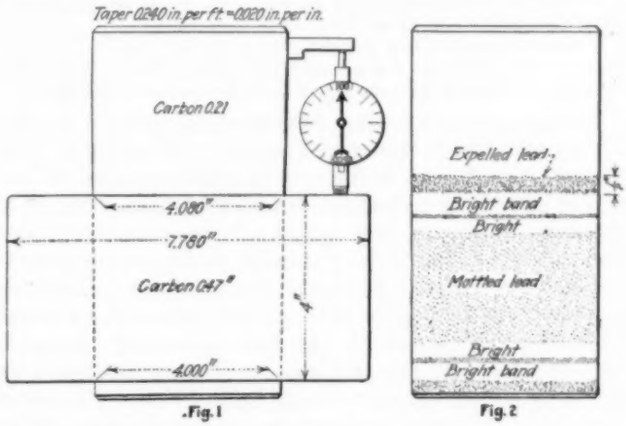


Fig. 1—Plug and ring for testing taper fits. Fig. 2—Pin after backing out of its own accord

common taper was $\frac{1}{16}$ in. per ft., but since this measurement involves odd decimals, Mr. Thomas, about 25 years ago, suggested a taper of 0.06 in. per ft., or 0.005 in. per inch. This slight change (for $\frac{1}{16}$ in. per foot is 0.005208 in. per in.) simplifies the measuring of both the taper hole and the relation between the movement of a shaft in the hole to the change in diameter.

With the old taper, for example, a hole 10 in. in diameter at the large end, would be 9.9948 in. at a depth of one inch and 9.9792 in. at a depth of 6 in. The slight change in the new taper changes the diameter an even 0.005 in. for each inch of depth, and the measurements of a 10-in. hole would be 9.995 in. at one inch and 9.980 in. at 6 in., respectively, from the end. On some work other tapers are used, but they are multiples of 0.005 in. per inch and retain the advantages of this ratio. Two other tapers used are 0.12 in. and 0.24 in. per foot or 0.010 in. and 0.020 in. per inch.

Some very interesting results of tests made with a plug and ring gage of the dimensions shown in Fig. 1 have been sent us by Mr. Thomas. The plug was of 0.21 per cent carbon and the ring of 0.47 per cent carbon. The dial gage shows the movement of the plug as it is

Experimental Tests on Taper Press-Fits with Varying Lubricants

Lubricant	Test No.	Pres'd In	Dia. Pres.	Tons In	Tons Out	Ring Expansion	
Dry	A	0.050 0.100 0.150 0.200	0.001 0.002 0.003 0.004	10½ 23 36 50	65	0.002	On Testing Machine, Speed of Penetration Low
30 drops machine oil	7	0.050 0.100 0.150 0.200	0.001 0.002 0.003 0.004	4½ 15½ 29 45½	60		
Thin white lead turpentine	8	0.050 0.100 0.150 0.200	0.001 0.002 0.003 0.004	7 .. 18½ 45	61		
Thin film of natural W.L.	9	0.050 0.100 0.150 0.200	0.001 0.002 0.003 0.004	12 18½ 32½ 45½	55		
Same as No. 9	10	0.050 0.100 0.150 0.200	0.001 0.002 0.003 0.004	10 21 34 48½	57½		
15 drops machine oil	15	0.050 0.100 0.150 0.200	0.001 0.002 0.003 0.004	8 20½ 33 43	53		
7 drops machine oil	18	0.050 0.100 0.150 0.200 0.250	0.001 0.002 0.003 0.004 0.005	8½ 20 33 46 60	60 80		
20 drops machine oil	25	0.050 0.150 0.200	0.001 0.003 0.004	12 22 33	51		On Hydraulic Press, Speed of Penetration Faster
20 drops lard oil	26	0.050 0.150 0.200	0.001 0.003 0.004	10 20 35	51		
Thin white lead	27	0.050 0.150 0.200	0.001 0.003 0.004	11 25 35	39		
Heavy lead	11	0.200 0.300 0.400 0.450	0.004 0.006 0.008 0.009	4 8 12 14	Backed Out Automatically. (See Fig. 2)	0.004	
Heavy lead	13	0.200 0.300 0.400 0.450	0.004 0.006 0.008 0.009	6 9 13 14½		0.004	
Driven in with 16-lb. sledge		0.200	0.004	8 blows	48		

forced into the ring. Each complete revolution of the gage hand equals a movement of 0.10 in. The taper is 0.24 in. per ft. or 0.020 in. per inch.

The table shows the results of several tests, both dry and with different lubricants. The first seven tests were made on a testing machine with a slow movement, while the next three tests were made on a hydraulic press at considerably higher speed. The difference in speed is believed to account for the lower pressure necessary to force the plug out of the ring, in the three cases noted.

The effect of lubricant on taper press-fits is clearly shown in all the tests, the dry fit requiring the greatest pressure both in and out. Tests Nos. 7, 15, and 18, all with varying amounts of pressure, are not entirely consistent, but as much so as might be expected.

The use of different lubricants was to show their effects on press-fits, not only on the pressure required to force the piece in but on the dependability of the fit after it is in place. The effect of white lead, which has probably been used since press-fits began, seems to be largely dependent on the amount used and on its consistency.

The thin white lead used in tests Nos. 8, 9 and 10, gave results not materially different from those obtained with oil in the other tests in the first group. But when a heavy coating of white lead was used, as in tests Nos. 11 and 13, the plug backed out of its own accord. It will also be noted that the pressure required to force the plug into the ring was much lower than in previous tests.

The appearance of the plug after backing out is shown in Fig. 2. Just what this means will probably be interpreted in various ways according to the previous experience of the reader. At first one might be tempted to suggest that the taper was not uniform in either the plug or the ring, and that the fit was not as perfect as could be expected. This assumption, however, can hardly be entertained when we consider the wide experience of Mr. Thomas in making and gaging taper fits, so the question of workmanship may be dismissed as untenable. Perhaps others have noticed similar phenomena.

The last test was with the same plug driven in by eight blows from a 16-lb. sledge. The eight blows drove it in 0.20 in. and it required 48 tons to press it out. These figures give some idea of the force that can be exerted by a husky man with a sledge.

High cutting speed does not always mean maximum production, because frequently the time lost in grinding and setting tools costs more than the gain. Then too, the idle time of the machine must be counted, particularly where it must stand idle until the cutter is ground. For lathe tools many consider that one hour between grinds is usually a fair limit.

Among the important things to teach a boy who is to learn the machinist's trade, are the principles involved in the machines he is to operate. Whether you stick to the old notion of six fundamental mechanical movements, of lever, screw, cam, wedge, pulley and gear, or boil them down to two—the lever and wedge, isn't important. But unless the boy understands leverage, he is sure to make a mess of strapping work on a planer, and cams and screws will be a mystery to him instead of an open book. Teach him "why" and then show him by actual examples.

Dimensioning Assembly Drawings

In offices where drawings of details are made largely on individual sheets there are found rather surprising differences in practice as to how far dimensioning is carried on drawings of those parts which are riveted or welded to others and subsequently machined (or at least fitted) so as to assure correct relations to other parts. It is believed that in these cases the better plan is to show the finished dimensions, including those of relations to other parts, with tolerances, upon the assembly (or sub-assembly) drawing; and to show upon the detailed drawing only the preliminary dimensions and the stock required for finish after assembly. The principal disadvantages of this method are that the assembly drawing is apt to be of a smaller scale and unless an additional and enlarged view be added for the purpose, the details of small radii, etc., are not so easily shown. There is also a view held by some executives that on work which it is expected will be done by contract it is undesirable to dictate to the contractor whether or not he shall finish such a piece in place.

Several Advantages

The advantages of showing the desired "relation" dimensions on the assembly drawings are that:

a. Except for the unusual shop, there is no question as to how far the work of finish is to be carried before assembly nor what the assembler must look out for.

b. The individual drawing shows the part as it passes through the inspection department.

c. It leaves the detailed drawing as one which may be used in several different constructions as, for example, in the case of a small forging for a clip having an opening which is to be finished after assembly to sizes suitable for embracing male mating members, but which is usually forged solid. The forging only may be adapted for several different positions in which the machining sizes or tolerances may be entirely different.

d. The part represented is more nearly what is desired for a spare part.

e. The constant repetition of the note "may be machined after assembly" on detail drawings is avoided.

f. Since one detailed drawing is used instead of several, there is less danger of duplicating forging dies or drill jigs because of failure to note the similarity between pieces.

The question of proper nomenclature arises. So far as the shops are concerned a simple piecemark or part number is sufficient to identify the part through all the processes of manufacture, inspection, assembly and storage. However, once out in service, such part numbers mean nothing if the handbook referring to them is not at hand. If they appear on the parts when new they are apt to be lost under paint or by wear of the surface on which the piecemark has been originally stamped. In many cases as on small springs, it is impossible to fix the identifying number on the part. For replacement purposes it becomes necessary to give each a name which should be either locational or functional and thus assist in exact description. Now, such a detail as we have described in the small forged clip may not have at all the same location or function in the different mechanisms for which it is used; consequently, the full name of the part cannot appear on the detailed drawing. The piece really is not worthy of a full name until it is finished in place and has actually become an integral part of the construction. On the detail drawing it should be simply A1633, a "clip." On the list of parts of a particular construction it may be referred to as a "jack fastening clip, right" or such name as may best suit its circumstances.

Characteristics and Uses of Ground Gears

By H. L. F. Orcutt
Birmingham, England

Wider use of ground gears predicted from success in automotive field—Design efficiency much improved by accurate tooth forms — Program of research

THE GROUND gear is practically a new mechanical product except in automotive practice where it has been adopted to some extent. Its use is almost unknown in general engineering and it is the purpose of this paper to describe the various features of the ground gear and to make suggestions for its application.

The two outstanding characteristics of ground gears are extreme accuracy and the possibility of making a straight tooth spur gear of a material with any desired physical properties regardless of the fact that such a material might otherwise prove very troublesome due to warpage, in particular, when hardened. Thus, any alloy steels or heat treatments can be specified and even with the hardest material accurate tooth finish can be maintained within small limits. For this reason case-hardened steel is quite popular for ground gears.

Ordinary commercial cut gears give satisfactory service when they are run at low speeds and are not overloaded. The same gears when run at high speeds are noisy and, unless lightly loaded, give only a short life. Both quiet running and long life depend upon the accuracy of the gear—accuracy that no cutting tool but the abrasive wheel can give. For instance, experience shows that for automotive work the errors in gear tooth shape, in the placement of the teeth, and in indexing must not exceed 0.0003 in. in order to insure quiet running. Special experience in highly refined grinding machines, together with precise and highly special measuring instruments and rigid inspection, is necessary to reach these limits.

Two Important Considerations

In straight spur gears all tooth action takes place by sliding and all tooth contact occurs on a line. This line of contact should be straight and continuous. Furthermore, since the load is transferred from one tooth to another with great rapidity (as high as 100,000 or more times per minute) the tooth spacing should be extremely accurate. Unless both of these conditions are fulfilled, noise will occur proportional to the magnitude of the errors.

The ground gear, finished to the degree of accuracy necessary to quiet running, possesses full theoretical efficiency in respect to life, load and stresses. Contact can be maintained along the full width of the teeth and with perfect regularity from the top to the bottom of the working surface. Ordinary cut gears, on the other hand, have irregularities of form resulting in constantly shifting high spots where stresses are concentrated. In order to allow for this condition, an extra amount of metal must be provided than would otherwise be necessary with a ground gear. This is particularly true of gears that are to be hardened after cutting, because of distortion. Usually, the particular alloy steels that have the best properties of strength and fatigue resistance, are the ones that distort the most.

For example, measurements made on a gear that was hardened, but not ground, after the teeth were cut showed a back-lash variation of as much as 0.06 in., out of parallelism of teeth 0.015 in., high spots 0.027 in., and indexing errors ±0.020 in., these figures all being maximum. If run at high speed it is quite evident that hammering would occur. Incidentally these irregularities would increase as wear takes place.

Automotive Gears Stronger

With full theoretical efficiency and no limitations respecting the choice of materials, ground spur gears can be designed with minimum dimensions, a valuable asset when there are limitations as to weight and space. As a specific comparison of this design efficiency, it may be mentioned that automotive ground gears successfully carry over 3,000 lb. per inch of face, while many electric railway pinions are only carrying 1,200 lb. per inch of face. Theoretically, the latter might be reduced in width to one-half if properly selected material were employed and the teeth were accurately finished by grinding after hardening. The factor of safety on such gears is now 16 on the elastic limit. The question is asked as to whether this factor might not be reduced to 5 with proper treatment. Automobile gears stand enormous shocks and great abuse with few failures.

The demand for gears running at very high speeds is rapidly increasing. Since straight cut gears will only permit of comparatively low speeds, recourse must be had to ground gears. Although there is not much information available as to limiting speeds, it is well established that ground gears will operate quietly at 3,000 ft. per min., and there are known cases where speeds of 10,000 ft. per min., or over, have been successfully attained with considerable power being transmitted.

Ground gears wear longer and show less signs of pitting action than cut gears. This fact checks up with the theory that the maximum wearing qualities exist in those surfaces which most nearly approach mathematical perfection. The fact that it is possible to maintain actual contact over a number of teeth, no doubt, contributes to this quality. The life of gears is also dependent upon the amount of back-lash as well as the accuracy of spacing of the teeth, both of which

Abstracted from a paper presented before the Institute of Mechanical Engineers, London, England.

may be definitely controlled with ground teeth. Tests on cut gears indicate in a general way the effect of inaccuracy in spacing when it was found that at pitch velocities of 1,000 ft. per min. gears, whose spacing errors did not exceed 0.001 in., would carry twice the load of those gears with errors of 0.006 in. The fact that the spacing in ground gears can be held within a few tenths of thousands, indicates what comparative results might be expected with ground gears.

The chief application of ground gears has been to the automobile transmission where there still remains some development work, notably in the component parts, to make operation really silent. Straight ground spur gears are beginning to replace the helical gear and chain drives for "timing gears." So far they have not found their way into the machine tool field, but it is fair to predict that with the probable increase in the use of non-ferrous metals, instead of cast iron, with their attendant high cutting speeds, the machine tool builder will be forced to adopt ground gears to eliminate noise in his gear boxes.

Suggested Specifications

Ground gears have been used in electric locomotives, using the same dimensions and specifications as for soft steel gears, and have shown excellent results as far as smooth running and long life are concerned. Undoubtedly, in these instances, excessive factors of safety have been used and the standards should be revised. It is suggested that the following specifications for electric railway motor gears be adopted: (1) Smooth finish on teeth, (2) a maximum back-lash of 0.02 in., (3) a maximum back-lash variation of 0.002 in., (4) parallelism of teeth, maximum error of 0.001 in., and (5) index errors from tooth to tooth in both gear and pinion not to exceed 0.0005 in.

Ground gears have a real place in the aëronautical field, where light weight and reliability are essential. They should also prove useful for rolling mills where heavy shock loads must be carried and where breakdowns must be avoided. Gear grinding on large diameters with fine pitches has not been much developed, but it is expected that the same accuracy as for small gears can be maintained. When that has been accomplished, we should find another new field of application in turbine transmissions.

Two methods of gear tooth grinding are in use, one by generating machines, the other by formed wheels. There are now on the market six different machines of the generating type, but so far as is known, none of the formed wheel type of machines are on the European market. Gear tooth grinding is on a commercial basis and accurately ground gears are available, but not in large sizes.

It is thought that the future of gear grinding will not be confined to hardened gears, but will also be applied to brass, fiber, cast iron, and soft steel gears where extreme refinement in tooth contact is called for.

There is a splendid field for research in this line, but the first object should be to discover the limitations of cut gears, particularly gears that have been hardened after cutting. Sufficient progress has already been made to indicate that any further progress in gear development is largely a matter of accurate finish. Having learned what is the maximum practical accuracy to which cut gears can be held, the investigator then knows the permissible minimum accuracy of ground gears and can proceed to find the point of maximum commercial grinding accuracy as well as that point, determined by satisfactory performance, beyond which no further accuracy is required. The investigator should also probe the exact relation between accuracy of form (and spacing) and endurance, between load carrying capacity and the two preceding factors, and also the relation between accuracy and noise, vibration and maximum permissible speed. Minor tests should include a study of pitch, angle of tooth, ratios, arc of action, number of teeth in contact, and the efficiency of the unit. To save production costs in grinding, exact hardening distortion records should be obtained in addition. The secondary effects of proper mounting should also be investigated, as poorly constructed gear boxes, loose bearing fits, and the like, often cause accurate gears to operate noisily. A more elusive factor is resonance, but it should by no means be neglected.

Tests made on cut gears show that the pressure angle has little effect on the bearing loads and performance. It would be desirable, however, to make further tests with ground gears along the same line.

The above suggestions for research are submitted for the special consideration of mechanical engineers. The tests should entail little expense, particularly if conducted under actual working conditions. It is believed that intelligent progress can come only by pointing out the present shortcomings and by indicating the path of future developments. With this object in view the above article has been written.

Real Service Work Is Appreciated

By C. G. Williams

As an inspector in one of the large shops of a railroad system, I was expected to solve problems of output with the tools at hand. One item was especially troublesome. There were two expensive tools of the same type, and I wanted to utilize one of them to make this item. For various reasons I did not write to the maker, but an occasion came that compelled me to visit a city near the town where the tools were built, and so I decided to visit the shop. I was received with open arms and hailed as a chance to sell another tool. A catalog was handed out, but no one had ever heard of this machine being used to make that item of railroad repair stock. A perusal of the catalog soon showed why no one in that office could tell us a thing about the special uses for the machine because one of the first phrases that caught my eye was the statement, "Railway officials have displayed great ingenuity in utilizing this tool for the saving of labor." That was it. The firm made the tool, but the buyer could think up things to be done with it.

In contrast, there is another firm in the same line of business that keeps a scout on the road looking for just such special jobs. He informs the engineering department and a way to handle the work on one of their lines of machinery is devised. When a solution has been found, circulars are sent to all users of the machines saying that such a job can be made on the machine in such a way as to save time and labor.

The few machinery firms who do this sort of missionary work can be counted on one hand, or else I have not been fortunate enough to meet their representatives in the shops where I have worked.

Ideas from Practical Men

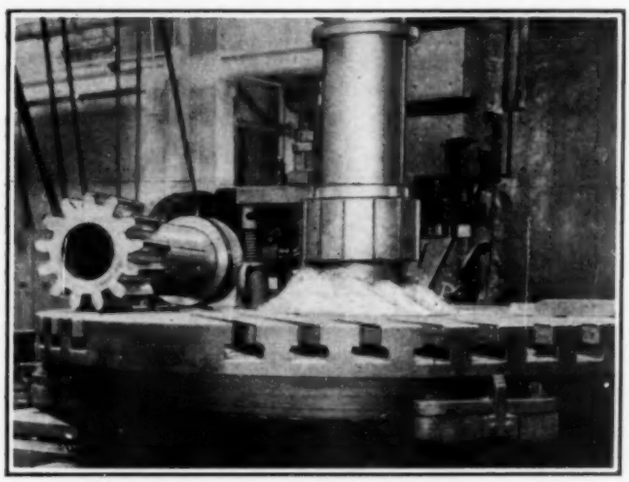
The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Cutting a Pinion on a Slotter

BY FRANK WALDO

Shops equipped with modern machinery generally can handle the average class of repair work without difficulty. There are cases, however, when an odd job necessitates the adoption of unusual methods. Such a condition was encountered recently in a mid-western railroad shop where it was found necessary to overhaul a wheel lathe, including the machining of new driving pinions. The pinions were of 1 diametral pitch and had 13 teeth.

Since the capacity of the average gear cutter would not permit the handling of the pinions, it was decided to use a slotter to cut the teeth, as shown in the illustration. After gashing with a straight tool, a formed tool



Set-up for slotting pinion teeth

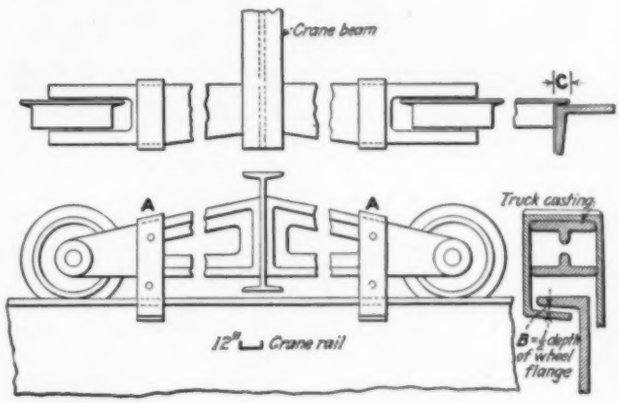
was used to bring the teeth to the correct shape. Indexing was accomplished by means of graduations on the table of the slotter. One of the finished pinions is shown on the left-hand side of the table.

Safety Guards for Crane Trucks

BY CLAUDE W. WRIGHT

Recently, I erected a 1-ton, hand-operated crane of the general design shown in the sketch. The wheels had flanges on one side only, and ran on one leg of the channels composing the track.

Due to the flanges of the wheels bearing against the webs of the channels, it was felt that there might be a tendency for them to climb the track and allow the



Guards to keep crane wheels from climbing

crane to drop, especially if the abutting joints of the channels should become out of alignment.

Considering the matter from the standpoint of safety, we made and applied the guides or guards shown at *A*, to prevent any climbing tendency. As can be seen from the sketch, the guards are very simple and can be made by any blacksmith or mechanic.

Uses of Stellite Welding Rod

BY ERNEST HUFF

The knowledge of the use of Stellite welding rod by the welders or machinists is very limited, inasmuch as the machinist does not realize the savings to be effected by its use, and the average welder does not even know what it is. I am sure of this fact because it took me six weeks to get a small amount when in need of it some time ago. Only the largest supply houses carry it.

Stellite welding rod has a low melting point. Care should be taken not to overheat it, since it becomes porous when overheated. I usually clean the steel it is to be welded to by the use of a bronze flux, but it will weld either with or without flux. A neutral flame should be maintained at all times. Care must be taken to add the filler rapidly to eliminate blow holes. The added metal cannot be filed and the only method of removal is by grinding.

The uses of Stellite for facing a soft-steel back with a glass-hard surface that will stand hard wear, or make a satisfactory cutting edge, are so varied as to warrant a thorough trial.

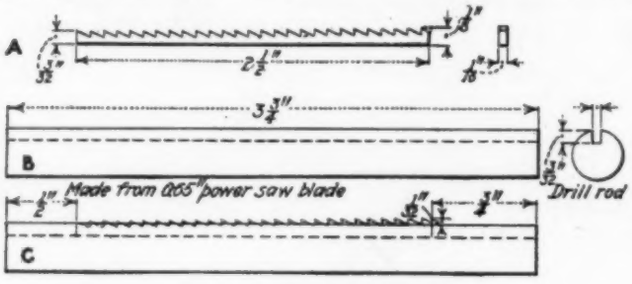
In building up a chipped punch or die with Stellite, immerse it in water, exposing only the portion to be welded. This precaution will prevent drawing the temper of the hardened surfaces.

An Improvised Broach

By Arthur R. Myers

I had fifty small brass gears to have ⅛-in. keyways cut in them, and they were wanted in a hurry. Since there were no more to follow, it was up to me to devise a cheap tool with which to do the work.

I decided to broach them, so I took a piece of saw blade from the power hacksaw and ground it as at *A* on the surface grinder. I then took a piece of drill rod,



The improvised broach

reduced the diameter so it would be a sliding fit in the holes of the gears, and cut a slot in it ⅛x⅜ in. the entire length, as at *B*. After tinning the saw blade and the slot in the drill rod, I sweat the two parts together, as at *C*. The small end of the saw blade was kept ½ in. from the end of the drill rod, to allow the rod to act as a pilot. The large end of the saw blade was kept ¾ in. from the opposite end of the drill rod, so as to allow the broach to fall through the holes after the last tooth had finished cutting.

The broaching was done in a small arbor press and the entire job was completed in 2½ hr., including making the broach.

The solder used was 40/60, because its low melting point would not endanger drawing the temper of the saw blade.

Utilizing Worn Boring-Bar Cutters

By R. E. Marks

After the cutters that come with the Davis boring bars have worn below size, they are utilized as holders or supports for boring bits, as shown in Figs. 1 and 2.

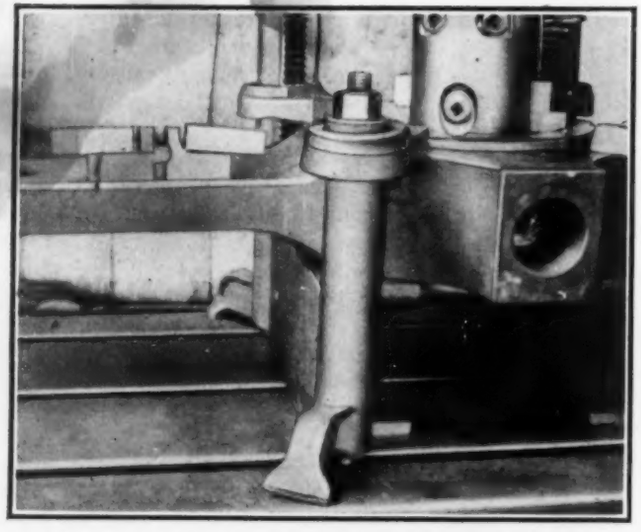


Fig. 1—A set of cutters at work on rod brasses

A corner is cut out of the old cutter and a piece of high-speed steel of standard size is put into the opening.

The new cutting tools can be clamped rigidly in place. They are found especially useful in boring rod-brasses as in Fig. 1. This method is used in the Battle Creek shops of the Grand Trunk Railway. The practice allows the use of standard sections of high-speed steel bars, that are simply cut off and ground to the proper size and shape for the work. They can be adjusted just as with the original cutters.

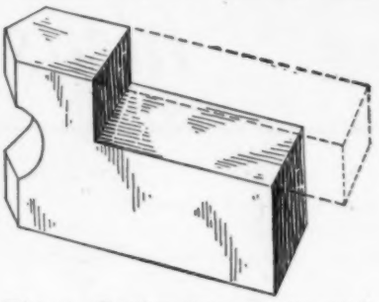


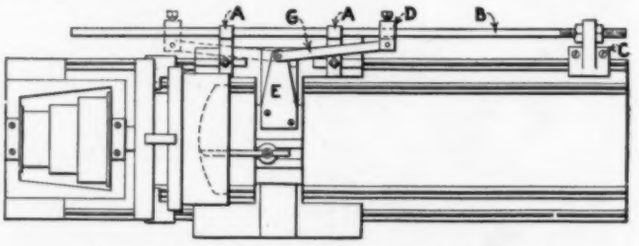
Fig. 2—Boring bar cutters with new boring bit

Attachment for Turning Concave and Convex Surfaces

By Joseph Havlik

The shop where I am employed makes a variety of tanks, therefore, a number of tank heads of various sizes, and the dies for making them, are needed. To machine the dies to the proper radius was quite a problem until I devised the attachment shown.

Parts *A* are attached to the wings of the lathe carriage and the shaft *B* is a sliding fit in them. One end of shaft *B* is fastened to the end of the lathe bed by the bracket *C*. Block *D* is arranged to slide on shaft *B*, on which it can be locked in any position by a setscrew. Part *E* is attached to the rear end of the toolblock.



Attachment for turning curved surfaces

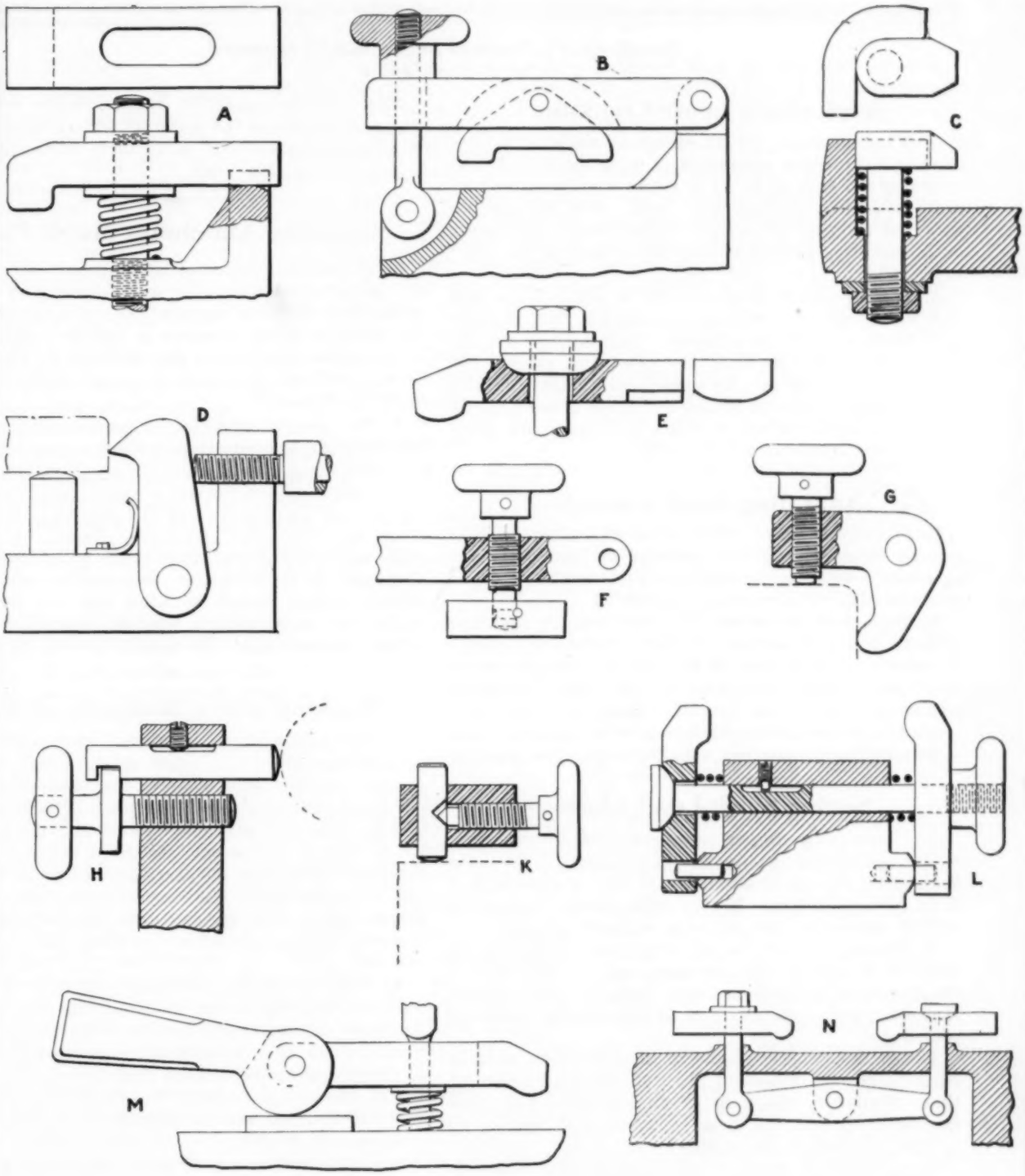
Part *G* is a piece of flat stock having holes drilled at the ends, the distance between them being equal to the radius of the curvature to be turned.

It will readily be seen that with the parts in place as shown, when the cross feed is operated the carriage must move along the lathe bed, causing the tool to describe an arc, the radius of which is equal to the center distance between the holes in bar *G*. Thus arcs of any radii can be turned by providing bars of the proper length.

It will be noticed that the bar *B* is attached to the bracket *C* by two nuts, and that there is a considerable length of thread on the rod. This arrangement provides a means of feeding the tool to the work in a lathe that has no compound rest, or when the compound rest cannot be swung around to the proper position.

When convex surfaces are to be turned, the block *D* is moved to the opposite side of the carriage and connected to part *E* by the lever *G* as before, as shown by the dotted lines.

Clamps for Jigs and Fixtures



A—Plain type clamp
B—Clamp for equalized pressure
C—Hook bolt
D—Knife-edge clamp
E—Clamp with rocking action
F—Clamp with swivel contact
G—Double-acting clamp
H—Clamp to avoid twisting action
K—Useful type of jig-leaf clamp
L—Double-type clamp
M—Cam-operated clamp
N—Double-equalizing clamp

Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Replacing a Loose Crankpin

Q. What allowance for fit should be made on a Corliss engine crankpin measuring 4¼ in. in diameter? The length of the fit is 6¾ in. The crank is of cast iron and the pin is turned from axle steel. We had trouble with the original pin which worked loose, and which on examination seemed to have fitted only at the outer edges.

A. It is customary to allow 0.001 in. press fit for each inch of diameter in making a crankpin fit. In your case, 0.004 in. would be sufficient. With the hole slightly out of round, as was likely the case when the old pin came loose, trouble may be experienced unless the hole in the crank is rebored before the pin is pressed in. If the original pin touched at points only, we would judge that the workmanship was defective.

Annealing Small Castings

Q. Please tell me to what extent annealing work is carried on small cast-iron castings for products such as sewing machines, so that the parts will lend themselves readily to subsequent machining.

A. We are of the opinion that the foundry practices used to produce castings of good machining characteristics are relied upon by the manufacturer to eliminate the expense contingent on an extra annealing operation. Annealing for the parts entering into sewing machines and similar products is used only when something has gone wrong with the mix in the foundry.

Setting Spirit-Level Glasses

Q. Please tell us the best hardening substance to use to set spirit-level glasses in their holders. We have been using plaster of paris, but it sets so quickly that it is difficult to use. Mixing with vinegar somewhat retards hardening, but not to a sufficient amount.

A. Plaster of paris is the proper and most reliable material to use for this purpose, and we believe it is the manner of application rather than the material that is causing your trouble. Let us suggest the following procedure:

The glass container should be inserted in its metallic holder. Then fold a short piece of paper a number of times similar to the folds of an accordion and place the paper so that the glass container will be held up against the top of the holder.

The plaster of paris is then mixed with water to just a liquid consistency with as little stirring as possible, since it is the stirring operation that causes the material to set rapidly. When the plaster has been thus mixed, it is poured into the metal container from both ends and allowed to set. Since the folded paper holds the glass in the stationary position, no further manipulation is necessary after the plaster of paris has been poured.

With this procedure, it is unnecessary to use any substance to retard the speed of setting of the plaster of paris, a practice that is, in fact, detrimental to the final quality of the work.

Repairing Aluminum Match Plates

Q. We use a good many aluminum match plates in our foundry and have experienced trouble in repairing them when they are accidentally cracked in ramming the mold, or when a corner is knocked off. Is there an aluminum solder or a flux that can be used in connection with common solder to repair such breaks or to build up a corner?

A. For general soldering purposes, a solder having the following analysis is suitable for your purposes:

Tin	55 per cent
Zinc	40 per cent
Aluminum	5 per cent

We suggest that you get in touch with the Aluminum Company of America for information concerning a welding solder known as Litot and for instructions in its use, as we believe welding to be a more satisfactory process than the usual soldering process.

Blanking with a Minimum of Scrap

Q. We desire to punch blanks, approximately 2 in. in diameter, from thin sheet stock, measuring 37 in. square, without leaving any scrap between successive positions. In other words, we propose to punch a continuous row of blanks along one edge of the stock, then follow with a second row staggered in relation to the first, and so on until the sheet is consumed. The material is non-metallic and works well under a punch. Please tell us how we can gage the perforations for accuracy and speed, and so one blank will not cut into another.

A. Since the blanks touch each other, it will be the most practical to use an indexing feed that will move the sheet automatically in step with the hits of the press. Such an arrangement is comparatively simple to devise and can be secured from those press manufacturers who also make press feeding devices. The operation will be rapid and one man should be able to handle a number of presses.

The stockholder can be made adjustable if it is so desired, so that sheets of varying sizes can be handled and moved into successive positions.

It should be understood that this arrangement of blanking without allowing even a small amount of scrap between blanks is not practical when working in metals that have any amount of ductility, as the wire edges will pull down between punch and die with possible serious effect.

Technical Abstracts

Production and Safety

Nearly all machinery is dangerous. Revolving flywheels, belts, etc., are all hazards. While they may be provided with guards, they are not always kept covered. The "point of operation" is nearly always open for the insertion of work.

All machinery must be fully guarded to avoid contact with moving parts. The removal of guards for any purpose other than repairing the machine, except in a very few cases, is a serious offense. A guard should be considered carefully from an engineering standpoint. A guard well made and properly applied becomes an asset, but a cheap, temporary affair is a dangerous liability, and often offers a worse hazard than does none at all. Robert H. Luckenbach, safety engineer, Edward G. Budd Manufacturing Co., in *Manufacturing Industries*, Jan., 1926, p. 25.

High-Power Metallography

High-power metallography consists in so preparing metallurgical specimens that crisp, brilliant images can be obtained and photographed at high powers, and in achieving approximately the potential resolving possibilities of splendid objectives. This tool for metallurgical research can be applied to the study of metal structures which heretofore have not been resolved and whose nature has lead to much speculation and to wide differences of opinion.

The best high-power objectives of 1.40 numerical aperture are capable, theoretically, of resolving about 140,00 lines per inch when used with a filter which transmits blue or blue-violet light. Even the most superficial examination of the work of metallographers will convince one that this theoretical limit has not been approached even remotely. Until it is attained the miscroscope cannot be regarded as an instrument which has yielded its full store of knowledge in the field of metallography.

Heretofore the practical limit to which magnification could be extended has been considered as about 1,500 diameters. If high magnifications are to be used, the specimen must be prepared with great care so as to bring out with brilliancy and contrast the particular elements of structure which it is desired to photograph. Starting with a very flat specimen which has been highly polished, the surface is delicately etched and the structure examined from time to time until the required degree of contrast has been developed in the particular constituent which it is desired to study, all else being neglected. Francis F. Lucas, in *Journal of The Franklin Institute*, Feb., 1926, p. 177.

Group Wage Payment

Where actual costs are determined on every job that goes through the shop, a very large cost staff is required under the individual system. Each man that works on a job turns in an individual time slip on that job. When the job is completed, all the time slips are assembled. The amount paid each worker on each time slip is found by multiplying the time earned or the number of pieces made, as the case may be, by each individual rate. The total of these amounts gives the actual labor cost of the job.

If the job comes through the shop later and is worked on by different men at different rates, the actual cost will be different. If a breakdown occurs while the job is being made and the worker neglects to turn in an extra time slip covering the delay, the job will be charged with the time lost, while in reality, it does not deserve this charge. Thus cost keeping under the individual system is complex, inconsistent, and inaccurate.

Under the group system, the cost is computed from the average wage rate of the group multiplied by the total time allowance for the job. This makes a very simple method of cost keeping. Unless the personnel of the group changes or unless there is an increase or reduction of wage rates in the group, the cost of making the job will be the same every time it goes through the shop. Minor breakdowns are not charged against any one job but are distributed over all the jobs. Harold B. Maynard and G. J. Stegemerten, in *Industrial Management*, Feb., 1926, p. 93.

Railway Gearing

Teeth of the old 14½-deg. Brown and Sharpe proportions would not, in many instances, meet the requirements of present day demands due to improper tooth shapes of pinions under thirty teeth. Either the teeth had to be undercut or both the flank of the pinion tooth and the face of the gear tooth relieved in order to avoid interference. Demands for better conditions resulted in the introduction by the General Electric Co. of the present efficient type of long and short addendum gearing.

The pinion has a longer addendum than the pinion of the Brown and Sharpe proportions and the gear a correspondingly shorter addendum. The advantages are: first, increased life due to increased strength and true involute profiles which transmit uniform angular velocity; second, smoother operating and, therefore, quieter gearing due to the increased arc of action; third, ease of cutter duplication. George L. Kotz, in *Aera*, Feb., 1926, p. 63.

Machine Tool Advertising

The machine tool industry has not realized its potentialities to the fullest. For the next five or six years the bulk of the business must come from the replacement of old machines. Machine tool advertising has been devoted to the job of selling and has been highly standardized. The insertions of one company have been so nearly identical with those of every other as to offer the prospect little consciousness of company identity.

The machine tool field is open to salesmanship, but to judge from the conventional advertising, the salesmanship is limited to the salesmen themselves. Means should be taken to correct this condition and to inject into advertising something of the vitality which spells successful selling. George Burnham in *Advertising and Selling Fortnightly*, Jan. 27, p. 25.

American Machinist

KENNETH H. CONDIT AND FRED H. COLVIN
Editors

Established 1877

A Non-Partisan Tax Bill

THE Congress of the United States is to be complimented for its treatment of the 1926 Revenue Bill as a non-partisan measure and for its success in formulating the best tax legislation that has been passed since the war. Economic laws were finally given due regard and the new law may therefore be expected to aid business.

That the total reduction authorized exceeds the amount estimated as safe by Treasury experts is probably not a serious matter, for the additional revenue that is likely to accrue because of the establishment of sane surtax rates will more than offset it. The President is wise, however, to call attention to the fact that the greater reduction must be considered when appropriation measures are discussed.

The usual "squawks" from friends of the people who resent the relief of the very rich from excessive taxation may be expected. Some have already been made. They will be accorded the attention they deserve by hard-headed business men who understand the economic relations between high surtax rates and tax-free securities.

The new law is not perfect but it approaches perfection far more closely than its predecessors. Let us hope that it may stand unaltered for some time.

Getting Best Average Results

WHEN we get our mind set on an idea it is very easy to see only the thing in which we are interested and to miss the main point entirely. Such an instance is that of an oil salesman who only thinks of the saving in friction due to improper lubrication, when the loss due to unnecessary repairs and delays in production when the machine is out of commission is of far greater importance to the average manufacturer. Not that we should neglect the friction loss or waste of oil but it is well to remember the old adage about "saving at the spigot and wasting at the bung."

Another case is that of the power factor where individual motors are used on machines. Power cost alone is not the deciding factor but rather the total cost as weighed against the advantages of avoiding even short line or jack shafts and belts, of being able to shift machines at any angle or to any position, and to run any single machine at will.

Is There a Limit to Overhead?

WHY some plant managers do not run their plants directly into the hands of a receiver is an unfathomable mystery. The type of manager who insists that overhead shall not exceed a certain fixed percentage is a fine example.

An engineer of some reputation was recently discharged after eighteen months of work for a manufacturing organization because the overhead rose from 145 to 200 per cent during his stay and as a result of his efforts. No account was taken of the fact that the cost of the product was reduced from thirty-five to twenty-seven dollars as a direct result of the improvements made in shop methods.

By all means keep the overhead down and bring it lower if you can, but don't do it at the expense of profits. Remember that in the final analysis the net profit figure is the only one that counts.

Speakers Who Talk Overtime

THERE is room for a device to aid chairmen of engineering meetings that will enable them to gracefully, but effectively, shut off a speaker at the end of his allotted time. And there are times when the audience would be relieved if it went off prematurely.

When a speaker is allotted 30 minutes he should either decline, if he feels the time is insufficient, or else confine himself to the schedule. It is unfair to the speakers who are to follow and to those in the audience who have come especially to hear other papers. Speakers who drag over their time are either inconsiderate or egotistical, or both. They embarrass the chairman, they usually bore the audience and they cut off questions and so prevent the discussion that adds so much to the value of any meeting.

A device that will automatically call time in some unmistakable manner, so that meeting schedules can be kept, would be welcomed both by chairmen and audiences the world over.

Just Suppose

JUST suppose that many executive committees were, instead of what they are, advisory committees. That the executives, who are their heads, were empowered to act according to their judgement of the advice received.

Wouldn't that arrangement save a lot of lost motion? Couldn't one man make up his mind a great deal faster than a committee can reach a decision? And wouldn't there be one man responsible then, when things went wrong?

Just suppose.

Shop Equipment News

Pratt & Whitney Vertical Surface Grinders, Model B, Improved

The model B vertical surface grinding machines manufactured by the Pratt & Whitney Co., 111 Broadway, New York, have been improved, and a direct-geared motor drive for the machine has been provided. The general design of the grinders, which are illustrated in Figs. 1 and 2, is essentially similar to that of the belt-driven models previously described on page 218, Vol. 36, and on page 533, Vol. 55 of the *American Machinist*.

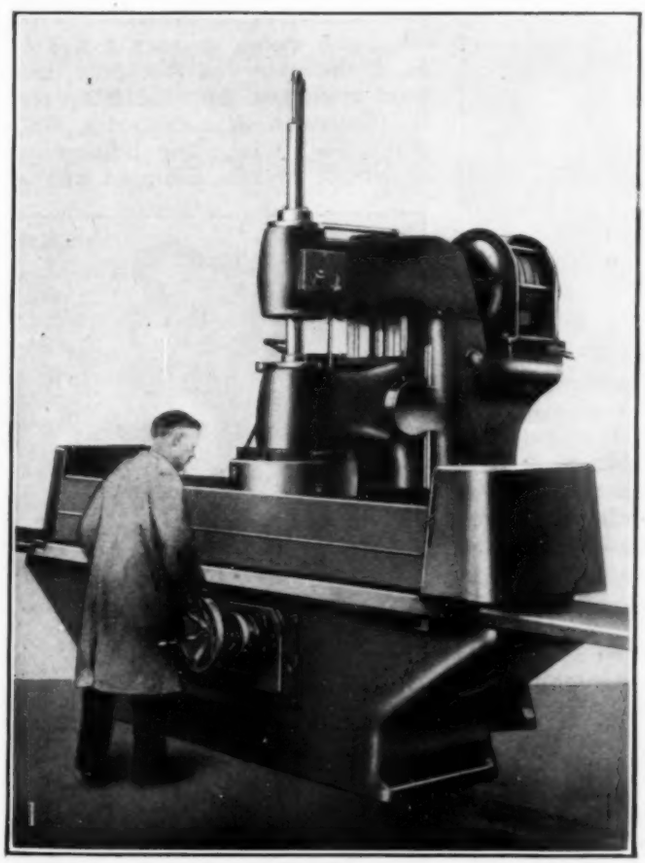
The improved grinders are being built in 14- and 22-in. sizes, the 22-in. machines being furnished with either a 4- or 7-ft. bed.

In order to eliminate the heavy belt tension necessary on the earlier models, and also the resulting wear on the spindle bearings, a direct-geared motor drive has been adopted. The construction and the arrangement of the drive can be seen in Fig. 3. The motor is mounted on a bracket cast in the rear at the top of the column. The motor drives the grinding wheel spindle through circular bevel gears in a right-angle drive. A 25-hp., 1,750-r.p.m. motor is used for the 14-in. machine, and a 40-hp., 1,150-r.p.m. motor is used to drive the 22-in. models. Motors can be furnished for either a.c. or d.c. current. The gears used in the transmission are made from heat-treated alloy steel.

The columns of the machines have been made heavier and more rigid, so as to provide a suitable support for the motor. The wheelhead and the spindle mounting have also been made heavier. The spindle rotates on ball bearings. The heavier construction and direct drive are said to have provided greater power at the wheel and to have increased the production capacity.

The grinding wheel is mounted on a faceplate that is bolted to the spindle, so that it can be easily removed when replacement is necessary. A sheet-metal guard covers the wheel, and a wheel band is also provided as a means of safety.

The wheelheads of both sizes of machines are over-counterweighted for easy and rapid adjustment and to prevent the grinding wheel from sagging. As an additional safeguard against the sagging of the grinding wheel, the entire spindle is floated



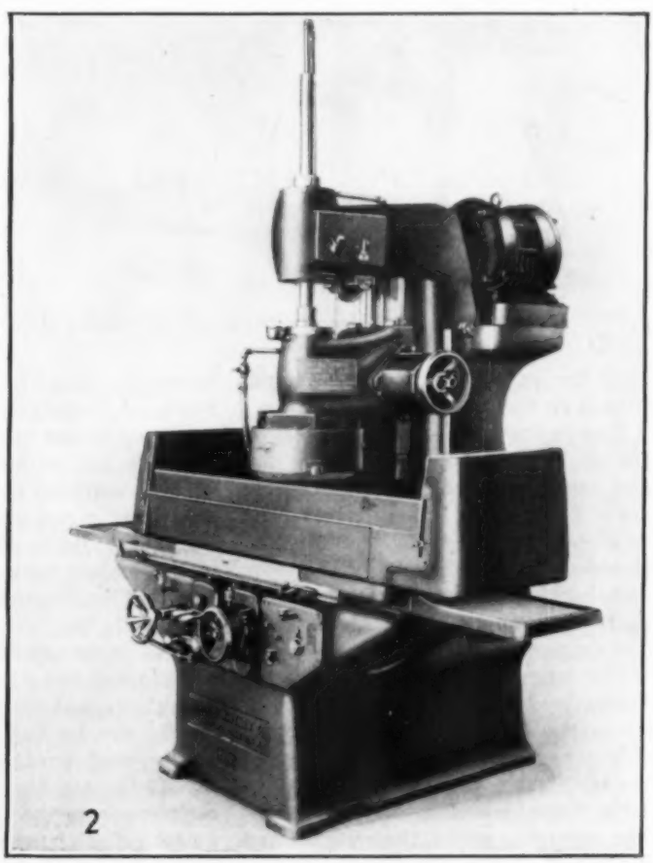


Fig. 1—Pratt & Whitney Vertical Surface Grinder, 22-in., Model B, Improved. Fig. 2—Improved Model B 14-in. vertical surface grinder

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on stiff springs that take up any wear that occurs.

The grinding wheel feed controls on both sizes of machines are essentially the same. The 14-in. machine has a handwheel at the side of the column for rapidly positioning the head. There is also a fine-feed handwheel at the front of the bed, by means of which the operator can bring work down to size when desired. A ratchet and pawl are attached to the front of the fine-feed handwheel to provide a power feed. This feed is operated from the table traverse. The 22-in. grinder has both the rapid- and fine-feed handwheels on the front of the bed.

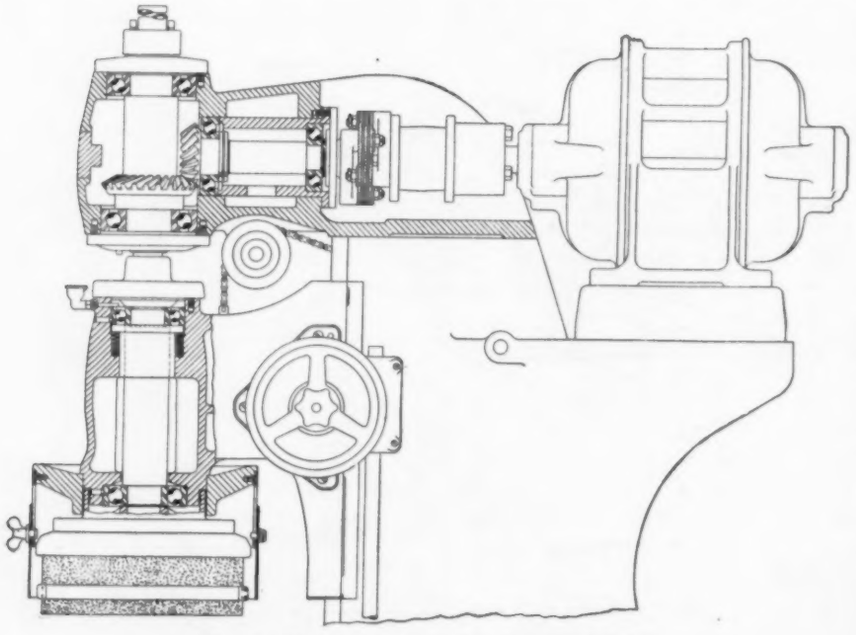


Fig. 3—Details of the direct geared drive

The reciprocating table is heavily ribbed and is mounted on one flat and one V-way, which are spaced far apart to provide full support. The solid top of the table and the end guards protect the driving pinion and rack from grit and moisture. T-slots accommodate work fixtures and magnetic chucks.

The length of the stroke and the reversal of the table are regulated by means of dogs which are adjustable along a T-slot in the front of the table. A safety dog prevents the table from running off the ways. The reversing gears, the clutches and the drive shaft are hardened and ground to secure strength and wearing qualities.

Two table speeds are provided on each machine, the operating clutch being controlled by means of a handle at the front of the gear box. The hand movement of the table is controlled by means of a large handwheel also at the front of the gear box. This handwheel may be loosened from its shaft so that it will not interfere with the operator when the machine is running.

The table ways are oiled automatically by means of spring oilers running in oil wells. The coolant is pumped through the hollow spindle to the wheel and is thrown out between the face of the wheel and the work. A supply of coolant is also conveyed to the outside of the wheel through an adjustable pipe. The spray is confined by means of adjustable sheet metal guards surrounding the table. Baffle plates are provided in the coolant tank so that it will be returned to the grinding wheel free from grit.

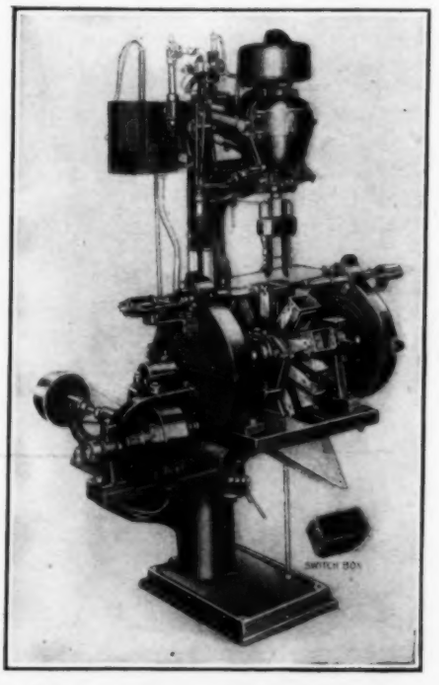
Both sizes of model B grinders are adapted for either rotary or rectangular chucks. Plain or magnetic chucks can be had in various types.

The work surface of the table of the 14-in. machine is 1x3 ft. The distance from the top of the table to a new grinding wheel is 14 in. maximum. The table travel is 43 in. The floor space occupied is 6½ ft. x 13 ft. and 2 in., including the table travel, and the height is 9 ft. and 5 in. The weight of the machine without the motor is 8,990 pounds.

The 22-in. grinder with the 4-ft. bed has a table working surface of 1½x4 ft., and the machine with the 7-ft. bed has a surface of 1½x7 ft. The table travel on the short machine is 58 in., while on the long machine it is 94 in. The distance from the top of the table to a new wheel is 17½ in. maximum. The floor space occupied by the short model is 19 ft. and 2 in. by 8 ft. and 10 in., including the motor. The floor space occupied by the 7-ft. model is 28 ft. and 9 in. by 8 ft. and 10 in. The height of each machine is 10 ft. and 7 in., and their weights are 16,500 and 19,250 lb. net, respectively.

Gaterman Pneumatic Oscillating Tapping Machine No. 4A1

The No. 4A1 pneumatic oscillating tapping machine, embodying essentially the same improvements as those described in connection with the No. 8 model, on page 182, Vol. 64 of the *American Machinist*, has been placed on the market by the W. Gaterman Manufacturing Co., Manitowoc, Wis. The illustration shows the machine equipped with a



Gaterman Pneumatic Oscillating Tapping Machine, No. 4A1

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special fixture for holding electrical switch boxes.

The operation of the machine is fully automatic. The operator needs only to load the fixture which has a dial feed. The parts are automatically clamped and discharged. The switch boxes have six holes to be tapped, two on each side and two on top. The tapping is accomplished by means of two vertical and four horizontal spindles. The same type of machine can be furnished for various parts having one or more vertical and horizontal holes to be tapped.

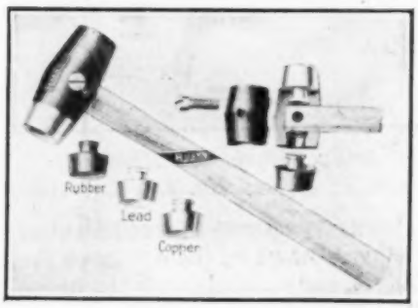
The operation of the spindle is such that when the strain on the tap reaches a certain amount, the limit of which is adjustable, the tap is slightly backed off the work and restarted in order to protect the taps from breakage.

All rotating parts are inclosed in guards as a protection from foreign matter and to prevent the throwing of oil. The oil pump has a fine mesh strainer and chip pan, which can easily be removed for cleaning purposes.

Husky Interchangeable Soft-Tip Hammer

The patent and manufacturing rights to the interchangeable soft-tip hammer illustrated have been acquired by the Husky Wrench Co., 928 Sixteenth Ave., Milwaukee, Wis. The hammer is made in 2- and 4-lb. sizes.

The hammers are supplied with interchangeable soft tips of copper, lead, rubber or other material as desired. They are marketed in sets with two of each kind of tip. The



Husky Interchangeable Soft Tip Hammer

tips can be replaced after loosening the fillister-head screw and separating the housings.

Heald "Size-matic" Internal Grinding Machine

The Heald Machine Co. of Worcester, Mass., has brought out a development of its internal grinding machine, to be known as the "Size-matic," by means of which holes that are parallel or tapered, plain or splined, may be ground continuously and automatically to size within very close limits. After the machine has been set to grind the desired size, no plugs, gages or measuring devices of any kind are put into the hole, either by the machine or its operator.

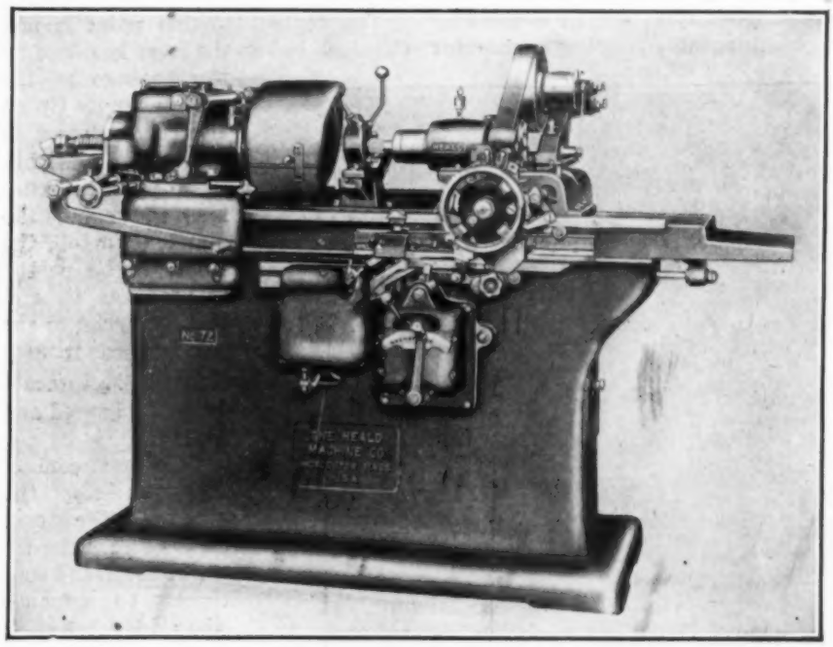


Fig. 1—Heald "Size-matic" Internal Grinding Machine

The machine cycle is as follows:

When the operator has set the piece to be ground into the chuck and tripped the starting lever—which is the table reversing lever—the wheel advances to the work and continues to reciprocate therein at a predetermined rate of table travel, at the same time being fed to the work in increments for which the cross-feed has previously been set, until the size of the hole being ground reaches a dimension that is a definite number of thousandths of an inch below the finish size.

The wheel then withdraws, a diamond tool drops into position to dress the wheel, and the wheel passes twice before it. The wheel then returns to the work and moves through it at a greatly reduced rate of traverse. After a short interval the wheel is withdrawn to its outer position and the cycle is complete. The foregoing movements are performed automatically the operator having nothing to do with them after loading the chuck and starting the cycle.

The number of passes through the work made by the wheel after it is dressed is variable in the setting, but once set for a given number it remains at that number throughout the job. The size of the hole is determined by the setting of the diamond tool, and is determined on the first sample when setting up the machine.

The theory behind the mechanism is that the dressing of the wheel at a certain point in the progress of the work establishes a basic size for all holes ground, regardless of the amount of stock to be removed from the individual holes during the first, or roughing, part of the cycle.

From this basic size, which prac-

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tice has shown can be maintained within one-half thousandth, the machine starts anew with a freshly dressed and trued wheel, to remove the very slight amount of stock remaining between the basic and the finish sizes.

The actuating medium by which the movements of the machine are brought about is a moving column of oil, maintained under considerable pressure by means of a geared pump of special construction, made by the company. It is a permanent part of each machine. The control is magnetic; the magnets being supplied with electric current by a continuously running generator which is also a part of the machine. They are contained in a box on the front of the machine, which can be seen in Fig. 1 to the left of the reversing mechanism.

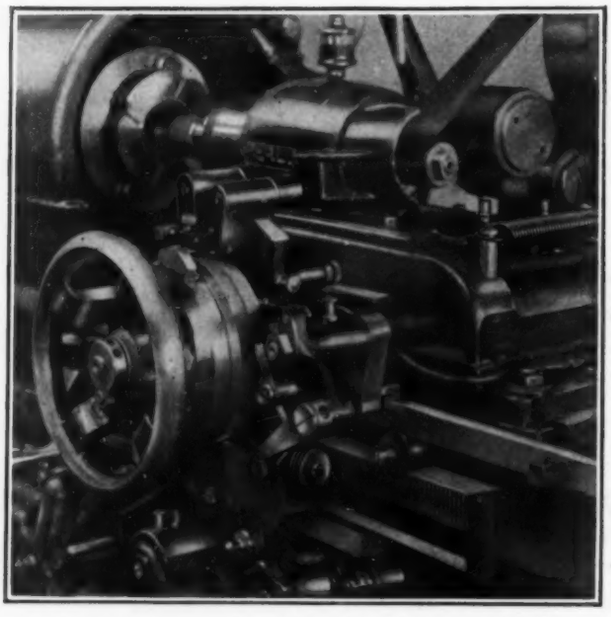


Fig. 2—Detail of automatic sizing mechanism

The machine is essentially similar to the automatic internal grinding machine made by the same company and fully described on page 410, Vol. 63, of *American Machinist*. The automatic sizing box that is the feature of that machine, has, however, been omitted and the control transferred to the cross-slide, as may be seen in Fig. 2. On the "Size-matic" no plug, diamond point, or gaging device whatever (except an occasional plug gaging, away from the machine, for purposes of inspection) enters the hole at any time. It is because of this condition that tapered and splined holes accurate to size, as well as parallel and plain holes, can be ground.

Referring to Fig. 2, there may be seen, directly over the feed ratchet, two contact points which are adjustable for a short distance to and from each other, the movement being in the arc of a circle which has the axis of the ratchet as its center. In contact with the nearer of these points may be seen a cam, carried on the periphery of a disk that is attached to and moves with the ratchet.

The contact at this point is mechanical, but as the lever is raised by the passage of the cam under its tip an electrical contact is established within the control mechanism that causes the diamond to fall, the wheel to be passed slowly over it, and then returned to the hole where it continues to reciprocate at reduced speed and feed.

The first contact does not stop the cycle. The cam passes under the tip of the lever and continues to advance slowly until it reaches the second lever, through which it establishes communication with the magnet box to cause the table to run out and all cycle movements of the machine to stop.

As the grinding wheel is being continually reduced in diameter by wear and repeated redressing, it is necessary to make compensation therefor, and this is a further automatic function. The ratchet wheel does not connect directly with the cross-screw, but floats upon it and transmits its movement through what is, in effect, an epicyclic train of gearing.

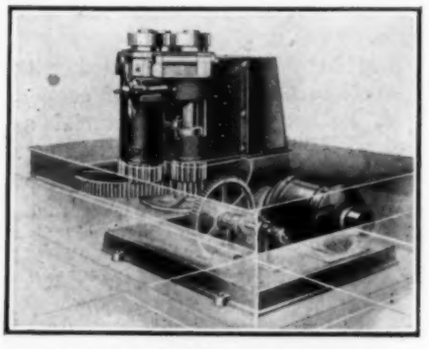
As the table runs out to the left an adjustable stationary cam strikes a lever of the feeding mechanism and advances the cross-slide 0.001 in. (or any predetermined amount) with relation to the ratchet. In consequence there is always a very slight amount of material to be dressed off the wheel each time it is presented to the diamond. As the relation of the cam to the ratchet always remains the same and the position of the diamond with relation to the work always represents the basic size of hole, the mechanism can be depended upon to reproduce a given size indefinitely during the life of a wheel.

The floor space occupied is 49½x60 in., and the weight of the machine is approximately 5,000 pounds.

Buffalo Horizontal Bending Roll, No. 1

The bending roll shown in the accompanying illustration has been built by the Buffalo Forge Co., Buffalo, N. Y. The machine is designed to accomplish the same bending operations as those done on the vertical type of machine previously described on page 70, Vol. 61 of the *American Machinist*.

The rolls on the No. 1 horizontal machine are arranged vertically so that the material worked on is in a horizontal plane. Rolls can be furnished to bend angles with the legs in or out, T-sections with the legs out, squares across the flats or corners, round or twisted bars, flats across or edgeways, rails, copper tubes of 12 or 16 gage, heavy and extra heavy as well as standard steel piping, I-beams on the web or on the flanges, and channels with the flange in or out.



Buffalo Horizontal Bending Roll No. 1

The machine is mounted on a cast-iron baseplate at the bottom of a pit 16½ in. deep, 73 in. long and 64 in. wide. Ten-inch channel irons, placed on the floor, support a ⅜-in. checkered steel plate which surrounds

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the machine. This plate or platform is 10 in. above the floor level, while the rolls are 36 in. above the level.

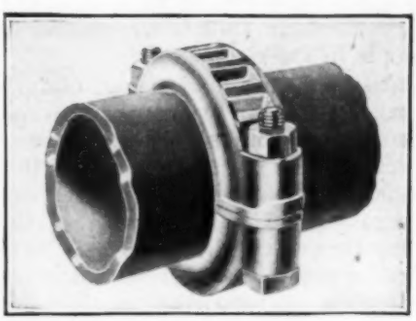
All gearing is now set in the pit. A 10-hp. General Electric reversing motor is used for the drive. It has a pinion keyed to the motor shaft. The driving gear is mounted on the main drive shaft of the machine. The heavy counterweight used on the vertical machine has been replaced with a coil spring. The hollow upright column at the back of the machine has shelves for storing additional rolls.

Lubrication of the motor and main drive-shaft bearings is taken care of by means of ring oilers. All other parts of the machine are fitted with Alemite connections.

It is said that the machine, in a test, has bent 2x⅜-in. flats into circles edgeways, in which the inside diameter was 13½ in. The maximum adjustment of the rolls is 1¾ in. to secure circles ranging from this diameter to any larger diameter desired. This adjustment is made by means of a capstan wheel at the front of the machine.

Victaulic Flexible Pipe Joints

A flexible joint for use in connection with steel, wrought-iron or cast-iron pipe is being manufactured by the Victaulic Co. of America, 26 Broadway, New York, N. Y. The joint is adaptable to plain-end piping that has a small groove near the



Victaulic Flexible Pipe Joints

ends. The groove is about the depth of the ordinary screw thread.

The joint, shown in the illustration, consists of a sectional housing which is clamped around the intersection of the pipe. Inside of the housing is a hollow inner ring. This ring seals the joint without pressure from the housing. The housing holds the inner ring in place, engaging in grooves in the pipe. An increase in pressure from the inside is said to add to the tightness and to the sealing qualities of the ring. An angle of 5 deg. on either side of the horizontal can be obtained by means of the joint.

It can be used on a vacuum or on a pressure up to 1,000 lb. It is claimed that lines equipped with the joints have been used over a period of five years for carrying oil, gas and water. The joints can be used on pipe lines where the temperature is not greater than 175 deg. F. Piping adapted for the joints is said to be now stocked in pipe mills.

Coats Ball Bearing Abrasive-Belt Grinders

The Coats Machine Tool Co., Inc., 108 West 40th St., New York, N. Y., has added to its line of belt grinders, previously described from time to

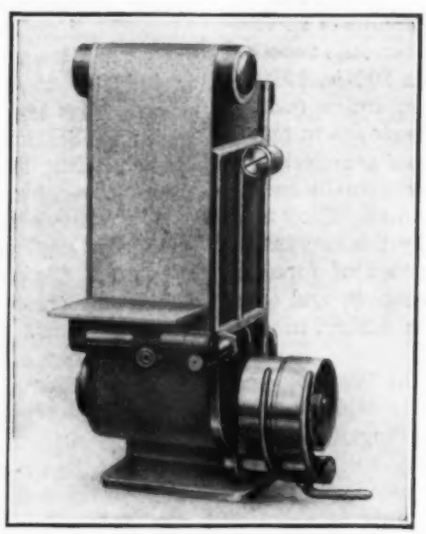


Fig. 1—Coats Convertible Ball Bearing Abrasive-Belt Grinder

time in the *American Machinist*, the two models illustrated.

The convertible grinder illustrated in Fig. 1 is shown bolted to an upright stand from which it can be removed and used as a horizontal bench-type unit. The table can also be removed and replaced with a guide bar.

The drums are 3¼ and 5 in. in diam., respectively, and are turned cylindrically instead of with a crown so that radius grinding can be done. The band tensioning is obtained by means of a positive adjustment.

Both drums and the loose pulley are equipped with ball bearings. These are mounted in dustproof housings and are packed in grease.

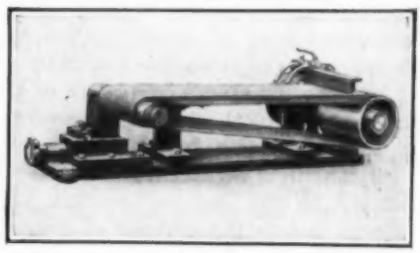


Fig. 2—Horizontal abrasive belt grinder

The machines are built in two sizes, Nos. 1 and 2. The grinding tables of the machines have surfaces 6½x14 in. and 6½x22 in., respectively. The belts are 6x41 in. and 6x57 in. for the two machines. The drums have center distances of 16 and 24 in., respectively. The net weights are 70 and 84 lb. and the upright stands weigh 30 and 50 lb., respectively. A leather clutch can be used for motor drive instead of the tight and loose pulleys which are 2 in. wide and 4½ in. in diameter.

The horizontal machine shown in Fig. 2 is also fitted with dustproof ball bearings. The front bearing is adjustable by means of a screw and a handwheel. The drums are 3 and 6 in. in diam., respectively. The abrasive belt is 8x73½ in. The center distance of the drums is 30 in. The pulleys are 2 in. wide and 7 in. in diam. The speed of the machine is from 800 to 900 r.p.m. and the weight is about 225 pounds.

Machinery Exports from France Increase

The manufacture of machinery in France in 1925 was characterized by a high degree of activity, according to a report to the Department of Commerce. The satisfactory operations in industry and the developments in exchange assured local manufacturers a good market, discouraged imports and stimulated exports. The shipments of industrial machinery by weight to foreign countries in 1925 were nearly double those of 1913. Because of these developments imported machinery has, in general, found a less favorable market in France. Foreign made machine tools, however, continued in fair demand.

Maintenance of Proper Relations Between Employer and Employee

By E. M. Herr
President, Westinghouse Electric & Manufacturing Co.

ABOUT two generations ago, the manufacturing industry was made up of small units each headed by an individual proprietor who knew all the parts of the business intimately and was in personal touch with his employees. Today we have large industrial groups employing thousands of men and requiring a well-organized body of employees led by an executive who is far removed from the workmen.

In the early stages of growth of these large manufacturing units, the workmen were often dealt with rather arbitrarily, which caused them to organize into "Unions" in order to cope with the management. Owing largely to the lack of contact with the responsible officers and to the absence of co-operative effort, there were frequent clashes which often resulted in strikes or lockouts. About ten years ago, progressive managers began making an effort to get into closer contact with their workmen and to this end encouraged the formation of committees of workmen in each plant, who could discuss matters of mutual interest with the foremen and other executives. Through these meetings agreements were reached which would otherwise have been impossible.

The Conference Idea

A great deal has already been accomplished by encouraging the formation of these committees in various industries. The number of works' councils reported in operation has increased from about 200 in 1919 to over 1,800 in 1924, affecting a million and a quarter workers, or about one-tenth of those employed in manufacturing industries. These committees are elected at regular intervals by ballot of the workmen in such a way as to make them representative bodies. They meet with a group of employees appointed by the responsible officials of the company, usually composed of foremen, assistant foremen, chief clerks, storekeepers, and other minor officials, with whom the workmen contact in their daily duties.

The joint conference committee of the Westinghouse Electric & Manufacturing Co. is a fairly representative example. This committee is called together every month or two by the works manager, who generally presides at the meetings. In order to avoid any feeling of bias, two secretaries are appointed, one representing the men, the other the management, and no permanent record of the proceedings is made until it is signed jointly by both secretaries. The minutes of each meeting are published in the *Shop News*, a paper which is printed at the company's expense and is distributed without charge to the employees.

Whether the joint conference committee idea is a pronounced success or a total failure will depend upon the manner in which it is handled. Enough evidence is at hand to show that a great deal of value, both to the employer and employee, has come from the establishment of a relationship that is co-operative in its character and educational to both parties at interest. With this relationship fully established, labor can play an important part in the industrial world if it will adopt a broader attitude than it has heretofore assumed. It should concern itself not only with those things which will further its own narrow interests, but also and principally with those things which are of the most benefit to all connected with the industry.

Abstract of address delivered before the Yale Divinity School and the New Haven Industrial Relations Council, January 9, 1926.

The Danger of Going Too Far

In certain directions, there is a limit beyond which it is unwise for either employer or employee to go. Co-operative effort to improve working conditions, wages, and hours of service, is very good, but the limit has been passed when reformers advocate giving a voice in the financial and business management to the workmen who have no responsibility for the operating results. A responsible management is needed to provide for the existence and the development of the industry, a result on which depend not only the interests of the owners and the public, but the employment of the wage earners themselves. The fallacies of socialism might easily destroy the entire structure. Any attempts to formulate new social creeds are dangerous because generalizations are almost always wrong in their application.

The prohibition of child labor, for example, appeals in principle to everyone as a necessary law, and it is such when used to prevent the exploitation of children in industry to their disadvantage or for gainful purposes. This law may, however, be made so restrictive in its application that children will be deprived of all contact with industry, thus making it impossible for them to receive that training and experience that is such a valuable part of early education. Of the children gainfully employed in the United States about two-thirds are engaged in agriculture, forestry and animal husbandry (principally in the South) and less than one-fifth in manufacturing and mechanical industries. The total number of children employed in all occupations decreased from two millions in 1910 to one million in 1920. This tendency is in the right direction.

The growth of industry during the last half century is one of the great achievements in history for improvement in the welfare of man. The purchasing power of wages is much greater than ever before, and this increase is proportionately greater than any increment which capital is receiving. The labor value of the employer's dollar has shrunk from 100 cents in 1914 to 44 cents. In 1923, a prosperous year for manufacturing as a whole, thirty-seven per cent of the corporations reported a deficit in their earnings. The improved condition of the workman has been brought about by shorter working hours and by the use of labor-saving devices to an extent that was not possible at the beginning of this period. Employers are spending a large and increasing part of their returns for the welfare, education and protection of employees and their families. The purchasing power of wages in the United States is the highest in the world. In southern Europe, it is quarter to a third of our standard.

News of the Week

An Analysis of the Revenue Act of 1926

Why Secretary Mellon smiled—New law yields $387,811,000 less than old law—Possibility of reserves for a 1928 law—More than half the reduction is in miscellaneous taxes

By Robert Murray Haig
School of Business, Columbia University

Newspapermen who observed the ceremony report that as the President signed the Revenue Act of 1926, Mr. Mellon smiled.

It is recorded further that, in posing for the picture which was to demonstrate to the country the non-partisan and harmonious character of the new act, Senator Smoot sought to clasp the hand of Senator Simmons only to find his fingers closing upon a half-smoked cigar. The cigar fortunately was out and Senator Smoot clasped only cold, dead ashes.

Suppose you were a Secretary of the Treasury who thought that the rich were being taxed too heavily but found that Congress did not agree with you. Suppose you had incorporated your ideas in a plan of "tax reform" and had appealed to the country over the head of that Congress. Suppose that Congress had bitterly resented this action and had with hauteur refused to accept your plan, finally, passing a law with maximum surtax of 40 per cent in place of the 25 per cent rate for which you pleaded, accompanying this action with violent attacks upon you, impugning everything from the purity of your motives to your sense of the fitness of things. Suppose you then changed your methods; you announced no plan of your own but modestly indicated a willingness to help Congress in any way within your power. Then suppose that, after the law had been in force only one year, Congress replaced it with a brand new law with a maximum surtax rate of 20 per cent. Do you think that you would be able to keep your face straight as the President signed the bill? Mr. Mellon is not to be criticized for smiling. Anyone but a veteran banker would probably have spoiled the party by laughing till the tears came.

Indeed there should be enough humor in the episode to supply Mr. Mellon with smiles for the rest of his days. Consider this situation for example. As will be seen from the accompanying table, the bill came from the House with a rate plan which reduced greatly the taxes on the very small and the very large taxpayers and which reduced only moderately the taxes on those with incomes of from $25,000 to $100,000. The Democrats in the Finance Committee of the Senate took up the cudgels for this middle class of taxpayers. Soon they proclaimed the achievement of a great victory. An analysis of this victory shows, however, that they accepted an arrangement under which, to secure an additional reduction of $490 in the tax of the $50,000 a year man, they gave an additional reduction of $700 to the $100,000 a year man and to all other taxpayers with larger incomes.

In December when the bill was under consideration in the House the writer ventured to say: "It seems highly probable that the Senate will change little in the bill except perhaps the rates, and that sometime in February the new act will go to the President for his signature." Although the President, by signing the bill on Feb. 26, did his part with two days to spare, the Senate was very inconsiderate of the writer's reputation as a prophet. The Senate changes were not few. They were numerous. At the risk of appearing spiteful the writer records it as his opinion that the Senate changes were too numerous.

Everyone knows, of course, that in times past the House has often sent crude and ill-considered revenue bills to the Senate. Indeed there have been occasions when everyone assumed that what the House did was of no consequence and that practically the entire bill would be written by the Senate Finance Committee. This year, however, such was certainly not the case. The House bill, although far from perfect, was a good bill and it is difficult to say whether on the whole the Senate changes improved it or marred it. Some changes were apparently made for no better reason than to create trading material for the conference. In trying to explain one such Senate change, an exasperated member of the House Ways and Means Committee remarked to the writer: "The only reason that I can give is that if we sent the Senate the Ten Commandments, they would want to amend them.

When the bill reached the floor of the Senate, certain amendments were made which were quite preposterous, and which could not hope to be retained in conference. "Go ahead and ruin the bill," shouted Senator Smoot in the midst of the performance. That the bill was not ruined was not the fault of the Senate. It was saved—conference. On the whole, the House emerges with its prestige very materially augmented.

The Treasury estimates that the new law will yield $2,365,189,000 during the calendar year 1926, which is $387,811,000 less than the old law would have produced. In 1927 the loss is expected to be less, only $343,000,000. These reductions are so substantial that concern is expressed regarding the adequacy of the yield to meet the government expenses. However, the Treasury estimates in recent years have been so conservative that the leaders in Congress are inclined to take with a grain of salt any gloomy forebodings emanating from the other end of Pennsylvania Avenue. Indeed some are already suggesting that there are hidden reserves in the estimates which will make possible a pre-election tax-reduction in 1928. Much depends, of course, upon the degree of business prosperity experienced during the next few years as well as upon the degree of self-restraint exhibited by Congress in its appropriations. All in all, it seems probable that the Revenue Act of 1926 will prove to be the last of all the great post-war tax reduction measures. Business should plan to

Reduction in Income Taxes

Assumptions: Taxpayer is married, with two children under eighteen years of age. His income in each case is 80 per cent salary, 10 per cent dividends, and 10 per cent interest, fully taxable.

Man's Income	Income Tax Under Old Law		Income Tax Under House Bill		Income Tax Under New Law		Per Cent Reduction House Bill as Compared With Old Law	Per Cent Reduction New Law as Compared With Old Law
	Amount	Actual Rate, Per Cent	Amount	Actual Rate, Per Cent	Amount	Actual Rate, Per Cent	Per Cent	Per Cent
$5,000	$18	0.3	$2.25	*	$2.25	*	87	87
10,000	121	1.2	67.13	0.7	67.13	0.7	45	45
25,000	1,375	5.5	1,003.75	4.0	1,003.75	4.0	27	27
50,000	5,755	11.5	5,078.75	10.2	4,598.75	9.2	12	21
100,000	21,935	21.9	16,228.75	16.2	15,528.75	15.5	26	29
500,000	196,535	39.3	114,228.75	22.8	113,528.75	22.7	42	42

* Less than one-twentieth of one per cent.

adjust itself to a long-time burden of approximately the present proportions.

Opinions as to the wisdom of the present slash in taxation vary widely. Many expect it to have a highly beneficial effect upon the business situation. The newspapers quote a banker as stating that the new law means $387,811,000 additional capital available for investment. Of course, no one can discuss such a point intelligently without making assumptions regarding the purposes for which the money would have been spent, had the reduction not been made. If it were spent for new battleships, the effect would be different from what it would be if it were spent for roads and schools. If it were spent for the redemption of Liberty Bonds, the amount of capital available for investment might be no greater or no less than it will be with the Revenue Act of 1926 in effect.

General Features of the New Law

The general character of the changes brought about by the new legislation can be grasped from a brief examination of the accompanying table. More than half of the reduction is made in the miscellaneous internal revenue taxes. The net reduction in the income tax is only $164,400,000. The capital stock tax is abolished at a loss of $68,500,000 this year. The estate tax is cut $15,000,000 and the gift tax repealed at a cost of $2,000,000. Taxes on automobiles, trucks, tires, etc., are reduced $82,150,000. Cigar taxes drop $17,000,000. No less than fifteen "nuisance" taxes are entirely swept away, reducing the list of the miscellaneous internal revenue taxes practically to pre-war proportions.

The struggle between the House and the Senate centered about the question of the retention of the federal estate tax. The final decision was in favor of retention (a wise decision in the writer's opinion) but at reduced rates (20 per cent maximum) with an increased exemption ($100,000) and with an increased credit for state taxes (80 per cent).

Although the net reduction in the income tax as a whole is only $164,400,000 the cut in the personal income tax alone is no less than $214,075,000 distributed as follows:

Increase in personal exemptions	$42,000,000
Reduction in the normal rates	46,000,000
Increase in the earned income credit	7,000,000
Reduction in surtax rates	119,075,000
Total	$214,075,000

This large decrease in the personal income tax is accompanied by an increase in the corporation income tax. The 12½ per cent rate has been raised to 13 per cent for the year 1925 and to 13½ per cent thereafter to compensate for the loss of revenue due to the abolition of the capital stock tax. This latter tax has been the cause of great complaint. Assessed as it was on the basis of a valuation of the stock, it involved much administrative difficulty and the corporations generally will applaud the change even though it means no reduction in their aggregate taxes.

Even if space permitted, it would not be desirable at this place to review in a comprehensive manner the various changes in income tax. The details of the changes of most general interest, such as the reductions in normal rates to 1½, 3 and 5 per cent, the reduction in the surtaxes to a maximum of 20 per cent, the increase in the earned income credit by permitting $20,000 to be considered earned, and the increased in the personal exemptions to $1,500 and $3,500, have been adequately reported in newspaper accounts and are set forth in the income tax blanks with which the reader will be struggling when this article appears. The higher personal exemptions mean that 2,300,000 fewer people will have to struggle this year than last. It may be noted in passing that the increased credit for earned income is a more substantial concession than appears on the surface. Under the old law a man with $20,000 earned income could at the most secure a reduction of $90. Under the new law such a person might secure a reduction of $250.

Aside from these changes, the modifications in the income tax are not numerous and those which merit comment in a general article are very few indeed. The publicity of tax payments is abolished, the Board of Tax Appeals is strengthened and a joint committee of five Senators and five Representatives is established to make a study of the revenue system in general. Depreciation actually sustained before March 1, 1913, must be deducted in arriving at the basis from which to measure gain when property was acquired before that date at a cost greater than the value on that date.

A new provision of the law and one which is being widely heralded in the newspapers as being wise and just is that which permits an individual citizen of the United States who resides abroad for more than six months of the year, to ignore entirely in making up his return "amounts received from sources without the United States, if such amounts constitute earned income . . ." The case for this amendment rests upon the alleged practice of other countries in refraining from taxing such income. As the situation now stands, however, if the foreign country in which the American trader is residing six months taxes him at a lesser rate than the federal rate, he is placed in an advantageous position as compared with the American trader at home. Again, even though the foreign country has tax rates as heavy as our own, the trader who is taxed on half of his income abroad and on half of it here, falls in the lower brackets in both countries. This, then, appears to be a subsidy to foreign trade at the expense of domestic trade which is far from wise and just.

Near the very end of the law, among the administrative provisions, appear two innocent looking sections (1207 and 1208) which were inserted at the last moment on the floor of the Senate. In spite of their innocuous appearance, it is not unlikely that these provisions may prove to have far-reaching consequences of a very undesirable character. They are designed, in the case of installment sales and in the case of invested capital computations, to legalize retroactively the Treasury interpretation of the law as far back as 1916.

It has been the theory of the federal tax administration that the Treasury shall construe the law strictly in favor of the government and that the taxpayer, if dissatisfied, shall seek redress in the courts. In the cases in point decisions have recently been handed down by the Board of Tax Appeals and by the courts which hold the old Treasury interpretation invalid. The amendments validate them retroactively. In effect, they give notice to taxpayers who disagree with the interpretations of the Treasury, that the Treasury will ultimately be declared to be right even though the courts say it is wrong and that even though the courts grant relief, the relief shall not be given. How any one would have the courage to contest a Treasury ruling under such circumstances is difficult to understand.

Estimates of Revenue for the Calendar Year 1926 Under New Law Compared with Estimated Yield Under Old Law

Source of Revenue	Old Law	New Law	Reduction
Income tax	$1,880,000,000	$1,715,000,000	$164,400,000
Miscellaneous internal revenue:			
Estate tax	110,000,000	95,000,000	15,000,000
Gift tax	2,000,000	.....	2,000,000
Capital stock tax	93,500,000	25,000,000	68,500,000
Tobacco:			
Cigars	43,000,000	26,000,000	17,000,000
All other	330,000,000	330,000,000	.....
Spirits	25,000,000	21,000,000	4,000,000
Automobiles:			
Trucks	9,000,000	.....	9,000,000
Other, etc	116,000,000	69,600,000	46,400,000
Tires, parts, etc	25,000,000	.....	25,000,000
Cameras and lenses	700,000	.....	700,000
Photographic films and plates	750,000	.....	750,000
Firearms and ammunition	3,850,000	.....	3,850,000
Smokers' articles	50,000	.....	50,000
Automatic slot machines	650,000	.....	650,000
Mah jong sets	1,000	.....	1,000
Works of art	650,000	.....	650,000
Jewelry	8,000,000	.....	8,000,000
Brokers	2,100,000	.....	2,100,000
Bowling alleys, pool and billiard tables	2,000,000	.....	2,000,000
Shooting galleries and riding academies	28,000	.....	28,000
Automobiles for hire	1,750,000	.....	1,750,000
Tobacco manufactures	1,120,000	.....	1,120,000
Use of yachts	300,000	.....	300,000
Opium dispensers	312,000	.....	312,000
Deeds and conveyances	4,000,000	.....	4,000,000
Other stamp taxes	46,000,000	44,750,000	1,250,000
Admissions and dues	33,000,000	24,000,000	9,000,000
All other	10,239,000	10,239,000	.....
Total miscellaneous	869,000,000	645,589,000	.....
Total of above	$2,749,000,000	$2,365,189,000	$387,811,000

Harvard Fellowship for Industrial Relations

Harvard University has just announced the establishment of a research fellowship for the betterment of industrial relations, the gift of the family of Jacob Wertheim.

The purpose of the fellowship is to enable persons who already have expert knowledge of plans for the betterment of industrial relations to pursue research that may be of general benefit in solving problems in this field.

Any mature man or woman having expert knowledge as above specified may apply. A university degree is not requisite.

The committee will be glad to receive an application from any person who believes he or she is qualified, and also will welcome suggestions as to eligible candidates from organizations for research, and from business or labor organizations which have had experience in this field. The fellowship is to be awarded by the president and fellows of Harvard University on the recommendation of the committee. Only one appointment will be made each year. The award will be for one year, but may be renewed for a second year, at the discretion of the committee. The holder of the Fellowship for 1926-27 will be appointed not earlier than May 15, 1926.

Marine Engine Exports Gaining Steadily

There was a decided gain in the motorboat and marine engine export trade of the United States during 1925, according to the automotive division of the Department of Commerce.

The value of motorboat and marine engine exports (excluding Diesel or semi-Diesel engines) increased from $1,310,067 during 1924, to $1,828,752 in 1925—representing a gain of almost 40 per cent. The total value of these items during 1923 and 1922 was $1,477,334 and $990,119 respectively, indicating an upward trend since the abnormal sales of 1921, 1920 and 1919 when the totals were $2,413,911, $4,291,904, and $4,722,389, respectively.

See Better Market for Machinery in England

Improvement in the British engineering trades, particularly automotive, created a better demand for machine tools during 1925, according to cable advices to the Department of Commerce from London. British production and imports increased and sales of American equipment expanded considerably, but low-priced German competition was keen.

Importers foresee better business with continued popularity for American quality tools. Ten new beet sugar factories are projected under the government subsidy. British textile machinery manufacturers anticipate an extension in domestic trade and expansion in the rayon and knit goods industries promises increased orders for American machinery.

This was a profitable year in coal-cutting machinery, but future prospects depend on the action of the Coal Commission and subsequent action in the mining dispute. The coal owners are favorably inclined toward improvement in coal mining equipment and methods. Road construction is active but public authorities favor British machinery. Tanning machinery sales declined on account of high prices and box-making machinery is in poor demand.

To Start Construction of Mammoth Airplane Plant for Ford

A new airplane manufacturing plant and a new hangar having a capacity for housing fifteen or more airplanes, forming one of the largest and most modern aircraft developments in the country, will be erected within the next few months at the Ford Airport, Dearborn, Mich.

This has been made public at the general offices of the Ford Motor Co., as plans are being completed for the plant which is to replace the building of the Stout all-metal airplane division of the company, recently destroyed by fire. The new airplane plant, which is to occupy part of the site of the former building, will be three times as large and will have a floor area of 60,000 sq.ft. It will be fitted with every modern facility for the manufacture of airplanes laid out in the standard Ford system of progressive production. Materials will enter one end of the building and proceed through the various stages of manufacture, emerging from the other end as completed airplanes.

Plans for the new plant call for a building 120 ft. wide by 500 ft. long and one story in height, of the same general construction as all the newer manufacturing and assembly plants.

An unusual feature of the building will be that it will have a full 120-ft. span from one side to the other without intervening roof supports, giving clear space for assembly of the airplanes. The roof will be of steel and glass and the exterior walls of buff brick, conforming in general design with the other buildings in the group at Dearborn. A heating plant will be erected in connection with the building.

The new hangar building, to be located adjacent to the manufacturing plant and on which work already is under way, will also be of buff brick but of different construction in order to accommodate the housing and easy handling of airplanes. It will be 123 ft. wide and 300 ft. long. An unusual feature is that each of the 300-ft. sides will be enclosed by steel and glass doors of special construction. This will permit the entire opening of either or both sides, the doors sliding back and folding into the ends of the building. This has been accomplished by effecting a roof construction of cantilever type.

An addition also is planned for the present Airport hangar which will house a dynamometer room for testing airplane engines as well as other test rooms. With the completion of the new hangar building, the present hangar, with its addition, will become more of a maintenance and repair station.

Arbitration Societies Form Merger

The activities of the Arbitration Society of America, Inc., the Arbitration Foundation, Inc., and the Arbitration Conference were taken over on Feb. 1 by the American Arbitration Association, which was created on Jan. 29 by an order of consolidation signed by a Justice of the Supreme Court of New York. The new Association has established offices at 342 Madison Ave., New York.

The consolidation order designated Lucius R. Eastman, Henry Ives Cobb, Anson W. Burchard, James H. Post, Frank H. Sommer, John F. Fowler and Felix M. Warburg as the directors to serve until the first annual meeting; at that time a full board of directors will be elected and the officers chosen for the ensuing year.

A program is now being perfected to maintain an information and consultative service to trade associations interested in creating or developing their own arbitral machinery and in promoting the general use of arbitration among their members in business disputes. A feature of this service will be the preparation and distribution of information bulletins on various phases of the practical functioning of commercial arbitration.

Employees Study Metallurgy at Carnegie Institute

A substantial saving is being made by at least four industrial firms in the Pittsburgh district this year under a plan whereby employees of these companies are conducting research work in metallography in the bureau of metallurgical research of the Carnegie Institute of Technology.

Listed as night students and scheduled to attend an advanced class in metallography once a week during the night college year, ten men are at work in the bureau this year conducting a unique experiment in co-operative research that may eventually result in the saving of incalculable funds to the metallurgical industries of the Pittsburgh district.

According to a report of the plan, the class of ten men took a night course last year in elementary metallography under Dr. V. N. Krivobok, research associate of the bureau of metallurgical research. After completing the elementary work, the students were offered the opportunity to continue their studies for the current year with the privilege of selecting their own or their company's problems in metallurgical research for intensive study.

Under the direction of Dr. Krivobok, the entire facilities of the bureau are available to the students. Among the problems under investigation are heat-treatment for the production of highest possible physical properties in steel castings of varied carbon content; heat-treatment of steels of exceptionally high-carbon content; investigation of low-carbon high manganese steels; investigation on aluminum steels; and investigation on dendritic segregation.

Philadelphia Club Studies Conservation of Power in Industrial Plants

Attention given to proper lighting of workshops

A study of the conservation of power by a more accurate knowledge of belting, lubrication of bearings and other important factors, made up the program for a meeting of the Engineers' Club of Philadelphia, held on Feb. 16, at its clubhouse, 1317 Spruce St., Philadelphia. Dr. Arthur M. Greene, Jr., presided at the first session and the conference was crowded with papers of special interest to plant managers.

William Staniar, transmission engineer, the duPont Co., told of the losses due to the improper selection and use of belting, considering it the most abused link in the power transmission chain, in spite of its being most widely used and indispensable for the operation of many machines. This he attributed largely to belt selection being left to untrained men who know nothing of the effect of chemicals or fumes on belts of various kinds. Samples of belts were shown that were completely ruined in six days, while a belt correctly selected for the purpose would last nine months. When the production of a $5,000 machine depends on a belt that does not cost over $50, it is foolish to haggle over a few dollars of first cost. Mr. Staniar stated that few machine tools were equipped with pulleys that allowed full power to be applied.

Selecting the Right Belt

The duPont and allied companies have evolved belt standards for various machines and conditions. These standards are the result of tests of the effect of acid fumes, steam, moisture, and other conditions; power to be transmitted; speed ratio; size of pulleys; angle of drive; top or bottom pull and the method of joining the belt. With these standards the transmission engineers can select the right belt for each place. Records show the best belt to be used, and in some cases a second choice. Records are, of course, necessary but after a belt has been found suitable, the cost of these records is not high. The flexibility of belt drive makes it more suitable in his opinion for many machines than a chain of another positive drive.

Under the title of "Lubrication and Bearings," John D. Gill gave a mass of data as to power losses due to lubrication and its effect on the total fuel consumption, etc. At his estimate that 3 per cent was lost in avoidable friction, the loss out of 278,000,000,000 hp. generated in the United States mounts to a surprising figure. When it comes to machinery and line shafting the loss is stated at a much higher figure, climbing to 65 per cent in some line shafts and with 10 per cent as a conservative estimate of all machinery.

Mr. Gill showed the effect of intermittent lubrication, and how an oil of high viscosity will give better results where oiling is uncertain, even though the friction may be higher than with an oil better suited to continuous and positive lubrication. He expressed the belief that bearings in the future must be designed to consider the viscosity of oil to be used and that machines will carry instructions as to the particular kind of oil to be used. A formula for finding the friction loss of a bearing was given as

$$\text{Hp loss} = \frac{0.000{,}000{,}01904\ N^2\ D^3\ L}{t}$$

where N = rpm, D = diameter of bearing in inches, L = length in inches, and t = the allowance for oil film in thousandths of an inch. Better design of lubricating devices and close study of lubricating problems will reduce losses.

The question of electric motor economy was brought out in a very interesting paper by Erb N. Dittenhofer, engineer of the Gotham Industrial Corporation, who gave specific instances of a low power factor in a textile plant. This paper has already been printed.

The last paper of the morning session was by Ward Harrison, on "Plant Illumination." Mr. Harrison gave many interesting examples and facts concerning proper and improper lighting. The value of different reflectors and different methods of lighting was illustrated and some rather startling figures given as to the light value of daylight. A man working in the shade on the north side of a building receives 500 times as much light as in what we call a well-lighted room.

Another phase of the lighting question is its effect on output, both as to quality and quantity. Experiments at the Timken Roller Bearing Co. showed conclusively the direct relation between the two. Increase in light gave more production and decreasing the light showed its effect immediately. In a similar way the White Motor Co. found that to secure increased accuracy, it was necessary to improve the lighting in the shop. All these factors are of direct interest to the shop manager.

The other sessions were devoted to the generation of power; the use of exhaust steam in process work; private plants instead of purchased power and vice versa, all by well known engineers.

Legal Permission to Pool Buying of Tin

The sub-committee of the Interstate and Foreign Commerce Committee of the House of Representatives which will investigate the foreign control of tin and other mineral commodities, will be urged by some of the witnesses who will appear before it, to recommend legislation which will make it possible for American consumers to pool their buying.

In the case of tin it is believed by some of the non-ferrous specialists in the government service, who expect to be called before the committee, that this would constitute an important safeguard. Were the two largest American consumers—the U. S. Steel Corporation and the National Lead Co.—to have legal authority to join in their purchases of tin, it will be contended before the committee, they alone could do much to insure against price inflation.

Some members of the committee favor the extension of testimony to include commodities not mentioned in the resolution. The thought is that the intent of the House is to have a clear understanding of the situation and this may require some inquiry into the situation surrounding other commodities.

Antimony is thought to present a slightly different phase of the problem. The producers of that commodity are understood to be anxious to increase their sales even at much lower prices than those now prevailing, but the amount of the material being allowed to reach the market is being manipulated by middlemen, it is claimed.

Ford to Manufacture Textiles for Autos

Purchase of a 1,705-acre tract of land between Ypsilanti and Rawsonville to be used as the site of a $3,000,000 cloth factory has been announced by officials of the Ford Motor Co. The company plans to manufacture all the cloth used in upholstering its cars. This marks another step in the concern's progress toward complete independence in the automotive manufacturing field. Work will begin April 15 on a huge power dam in the Huron River, south of Ypsilanti, that will create a five-mile lake. At the dam a hydro-electric power plant and auxiliary steam power plant will be erected to operate the factory.

Last year's cloth required the wool of 2,500,000 sheep, the company estimated. There are about 1,200,000 sheep in Michigan, the twelfth wool-growing state in the country. Ypsilanti, moreover, is in the center of the wool map of Michigan. with Washtenaw County leading other counties with about 70,000 sheep. The upholstering cloth and linings will be made directly from the raw wool at the new factory. The Ford Motor Co. now buys most of its cloth from the New England states.

The factory will probably be in two units each measuring 350 x 1,000 ft., and is to be completed in about two years. For this project the company bought 1,705 acres of land for $600,000.

In preparation for the creation of the five-mile lake, in which water will be backed up nearly to the southern limits of Ypsilanti, 1,000,000 ft. of lumber has been cut from the Huron River valley, including 150,000 ft. of black walnut. The dam and hydro-electric power plant, costing $1,200,000, will create 4,500 hp. for eight hours a day. The dam, 34 ft. high, will be the largest in the Huron River. The lake will be from a half to three-fourths of a mile wide.

About $60,000 has already been spent in grading a 100-ft. right-of-way for a siding to extend three miles from the Michigan Central R.R. south to the factory and power plant.

Machinery Industry in France Hampered by Outside Competition

Labor well employed in metal-working trades

BY OUR PARIS CORRESPONDENT

The metal manufacturing trades in France are estimated to have tripled in number and output since the war. The Metal Trades Federation feels and fears German competition more than ever before and likewise demands tariff protection, if possible a surcharge against German products. In a way the same feeling exists against all other imports of metal manufactures. Germany actually exported to France before the war tools, machinery and metal manufactures to the value of 1,250,000,000 francs, figured in the value of the paper currency of today. If this figure is again reached it is said to mean a loss of half a billion francs a year in wages which would otherwise be paid to the French workman. The lesson of this lies in the fact that the human wage bill in France forms the major part of costs in the trade, whereas it might be greatly reduced by the adoption of more efficient machinery for operations today carried out by hand. The aspect suggested is continually cropping up, but few have the courage to point to the logical solution for increasing production and possibly lowering of prices.

TOOL INDUSTRY QUIET

French tool and machinery industries appear to have languished during the past weeks, but in many lines 1925 business has been quite up to expectations, particularly with respect to textile and agricultural machinery, the reverse being true of the automobile industry. The International Harvester Co.'s French plant at Lille and that of the Bliss Co. at Saint Ouen, are two distinctive American elements operating on their own account in France and are soon to be added to on a large scale by the new Ford organization at Asnières and the Massey-Harris plant in the North.

The agricultural machinery exposition at Paris which has just closed its doors showed the great strides which this industry has made of late in France. Foreign participation was also notable, with that of the United States to the fore.

General movements of purchases and sales have for ten weeks past been artificially sustained by the fear of still further rising prices, the prevision of which has actually come to pass.

Ship production is by no means up to capacity of available facilities with the modern tool and machine equipment which the builders now possess. The average price for a series of new destroyers for the government works out at ten thousand francs per ton ($375, or rather less at the current rate of exchange) and this is believed to be a low record for France.

France is exporting machine-drawn wire to the extent of 108,000 metric tons per year according to the latest figures. This is an increase of thirty thousand tons over that of 1924 and almost a total increase over those of 1913. It is feared, however, that this infant industry will be seriously affected by the proposed German-Belgium wire combine, which, by the way, France was invited to enter but up to this time has refused.

The German chairman of the consortium states: "Together we shall dominate the world market. American production for export will have but little effect on our trade. We shall be the greatest producers of wire and wire goods in the world when our combine comes into being. We hope that it will be possible to arrive also at an understanding with France."

FRANCE BOUGHT LESS

At the annual meeting of the American Chamber of Commerce at Paris it was stated that, based on the figures of the American Consulate General at Paris, of total United States exports in 1925 seven per cent went to France, and that of imports 4 per cent came from France. French imports from the United States amounted to 16 per cent of the total imports while exports to the United States amounted to 12 per cent of the total French exports. Great Britain, Canada and Germany were shown to be larger buyers in United States markets than France while exports from France to Great Britain and the Belgo-Luxembourg Union were considerably greater than to the United States.

TRADE INCREASED

French foreign trade for the entire calendar year just past increased as to imports neary four billion francs and as to exports showed an increase of nearly three billion francs was recorded.

Imports from the United States, Great Britain and Germany all increased and exports to the same countries indicated an increase only to Great Britain.

The decrease of value of exports to the United States was but slight. This, according to French statistics, was slightly less than 100 million francs in value out of a total trade of 3,058,132,000 francs. The balance of foreign trade in favor of France for the year was slightly less than four billion francs.

The labor demand is still enigmatically insistent though mid-winter dullness should logically make the demand somewhat less. The metal and machinery trades made demands on the government labor bureau in excess of the supply offered. Again, in a single week this department found work for nearly three thousand foreigners for which no French labor was available. As usual Belgians, Italians and Spaniards were the more numerous, with Poles next in line. It is stated in opposition to the free entry of foreign labor, which apparently is needed, that 300 million francs are taken out, or sent out, of the country per year and that this in the natural course of events ought to remain with the French worker. Material and irrefutable conditions do not apparently permit this, however.

The only notable unrest in the labor situation is again signalled from the Lyons district where the Chamber of Mechanical Industries claims that manufacturers are not very prosperous and that a part of what should rightly be their profits is being paid out in increased wages. Any further collective demands for a rise in wages will inevitably bring shut-downs in thier wake and this, for the workers at any rate, will amount to something worse than the present condition.

Enlarge Scope of Research at Illinois University

To assist in the conduct of engineering research and to extend and strengthen the field of its graduate work in engineering, the University of Illinois now maintains fourteen research graduate assistantships in the Engineering Experiment Station at Urbana, Ill. Two assistantships have recently been established under the patronage of the Illinois Gas Association. These assistantships, for each of which there is an annual stipend of $600 and freedom from all fees except the matriculation and diploma fees, are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering, physics, or applied chemistry.

An appointment to the position of research graduate assistant is made and must be accepted for two consecutive collegiate years of ten months each, at the expiration of which period, if all requirements have been met, the degree of Master of Science will be conferred.

Nominations to these positions, accompanied by assignments to special departments of the Engineering Experiment Station, are made from applications received by the director of the station each year not later than the first day of April. The nominations are made by the executive staff of the station, subject to the approval of the president of the university. Nominations are based upon the character, scholastic attainments, and promise of success in the principal line of study or research to which the candidate proposes to devote himself. Preference is given those applicants who have had some practical engineering experience following the completion of their undergraduate work. Appointments are made in the spring, and they become effective the first day of the following September.

The Engineering Experiment Station, an organization within the College of Engineering, was established in 1903 for the purpose of conducting investigations in the various branches of engineering, and for the study of problems of importance to engineers and to the manufacturing and industrial interests of the State of Illinois.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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"ARE the 'Big Fellows' Out?" is the heading of an editorial published in a New York business paper last week. It has attracted a good deal of attention, and as it seems to sustain the theory that prices in the stock market are controlled by an anthropomorphic group, or individual, it may have been partially responsible for the decline in the security markets last week.

But in so far as it implies that the stock market is controlled by some financial superman, or supermen, it is misleading. The buying or selling power of the public far exceeds that of any individuals or group of individuals. The reaction that has occurred in the market value of securities reflects the public reaction to the facts of the situation rather than the coercive power that bankers are mistakenly supposed to possess.

Since the beginning of February, when the Stock Exchange published a statement showing the amount that brokers were borrowing, and the United States Government undertook to arraign some of the industrial consolidations that were being planned it has been plain that the public enthusiasm for higher prices was on the wane. The natural sequence was an effort to liquidate some of the securities carried on margin, and the consequence has been a decline in prices.

This decline is not intrinsically significant, but it has affected all the markets that are commonly called speculative. At the end of the week the average price level of both stocks and commodities was the lowest of the year.

This is not to say that it is low enough to be disturbing.

The reaction was entirely natural. Activity is first succeeded by lassitude and then by fatigue. The markets have hardly reached a condition of acute fatigue as yet, but it is evident that a period of rest will not be unwelcome and when it comes it may extend itself into the spring.

The commodities that are speculatively dealt in are almost without exception lower. It seems impossible to rally wheat or corn, although both appear to be in a strong statistical position. It is unlikely that Secretary Jardine's proposal to impose a limit of one million bushels upon the long or short interest in grain that any one trader may carry will be accepted by Congress, but suggestions of this sort chill speculative enthusiasm and are leading a good many American operators to transfer their business in wheat to the Winnipeg exchange.

The cotton market is substantially lower. The decline is a logical sequence of the disparity between the value of cotton in this country and Europe. The American price was so much above the equivalent of European values that the export movement had been checked, and the resulting congestion created what might be called an inverted position. When the export movement becomes normal again the decline probably will be at an end, but the foreign demand is still poor and as the hope of any reduction in next year's acreage has been abandoned a further drop will not be surprising.

Responding to the decline in the raw material, cotton goods are distinctly easier and buying orders are small. At its opening of fancy woolens and worsteds the American Woolen Co. has made some further reductions in prices, and the raw wool market, though dull, is rather lower.

Rubber has declined to 54 cents, which is the lowest price touched since Mr. Hoover opened his guns on the Stevenson plan. The trade idea seems to be that 25 cents is a fair price for rubber, but the success of Brazil in the "defense" of coffee will probably inspire the rubber producers to protect themselves if they are pushed too hard, for while governmental price control has killed all speculation in coffee it must be admitted that it has maintained values at a higher level than would have otherwise prevailed.

Therefore, it is not surprising that Cuba has taken a leaf from the books of the rubber and coffee producing countries. The Cuban Senate has passed a bill creating a national committee for the defense of Cuban sugar. The plan that this committee will follow has not been perfected.

Distributive trade throughout the country is upon the whole satisfactory. But one prominent New York trust company doing a national as well as an international business reports "a moderate slackening in several branches of trade and industry during recent weeks."

Increased shipments of steel are reported by the mills, but new orders are not quite up to what had been expected, and the fact seems to be that most of the steel required for the railroads and the new building now in progress was contracted for some time since.

There is nothing new in the foreign situation. Franch francs have recovered from the low prices of last week on reports that the Chamber of Deputies would adopt some really constructive financial measures, but no definite announcement has as yet been made.

The money market is unchanged and the Federal Reserve statement, which shows a reserve ratio of 74.0 per cent, needs no comment. It assures an abundance of bank credit in the immediate future and some high authorities are proclaiming that a money panic has been made impossible.

The consolidation of the Philadelphia National Bank and the Girard National Bank in one institution that will have resources of $250,000,000 is another item of news that will interest bankers.

What's Doing in Industry

The month of February closed with a total volume of business that, while it did not equal the total of January, was quite satisfactory to the majority of machinery and machine tool dealers and manufacturers. The most significant development of the month was the large number of inquiries received from all sources and for all types of equipment. This forecasts a good spring business that should carry over well into the summer.

Automobile manufacturers in Detroit continue to furnish excellent business. Expansions in many plants, and new developments in others, have again brought about increased activity. Road building and public works construction have also furnished some good business in this district. Cincinnati reports sales as being ahead of the previous week, and also an increase in the number and quality of new inquiries.

The new England district continues to advance, orders for special machinery being placed, and most shops are working to capacity. New York dealers report an active demand for small tools and shop equipment, with good inquiry for future purchasing of larger tools.

The South is active in practically all industrial lines, railroads and building contractors being active buyers. In Philadelphia industrialists are inquiring for machinery and a lively spring business is predicted.

Distributive trade throughout the country is upon the whole satisfactory and the financial situation has not lost any of its strength.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

New York

Small tools and shop equipment show to best advantage in total volume of sales in this market. Machine tools are moving fairly well, but most orders are for single pieces in types that are designed especially for some high-production work. Industrialists are the best customers, with small machine shops and specialty manufacturers coming next.

Railroad activity is good but orders are slow in closing. Present inquiries show an imposing volume of prospective business, but there is uncertainty as to when actual orders will be placed.

The larger manufacturers are buying in small quantities of scattered types, mostly for replacement of obsolete machines. Buying for expansion has not yet offered any great encouragement to dealers up to the present, but lists already out give promise of large orders in the near future.

Orders placed last week included: Two 13-in. lathes, 4 bench lathes, two 16-in. lathes, 6 automatic milling machines, 3 profiling machines, 1 automatic centering machine, one 10-in. lathe, one 14-in. lathe, 3 hand milling machines, one 6-in. vertical shaper, 1 vertical surface grinder, 2 jig boring machines, 5 hand screw machines and two radial drills.

New England

Machinery requirements for manufacturers of radio parts are beginning to loom up, judging from the increase in the number of inquiries received in this section. During the past two weeks preliminary inquiries have come from scattered sections and a conclusion reached is that this industry is going to furnish a good volume of business.

There is also a better inquiry in regard to special machinery. Specialists indicate that the prospects are promising both in immediate business and future requirements.

Production in automatic machinery continues at a satisfactory rate. There appears to be a disposition on the part of small tool manufacturers to go beyond the immediate production requirements in anticipation of continued good business.

Salesmen report a fair amount of buying in the New England territory, most of it being replacement business.

Plant operations are on full-time schedules practically everywhere, with maximum working forces.

Philadelphia

Industrial conditions in Philadelphia and the surrounding territory continue to present a favorable condition. There has been no development of an outstanding character to indicate a vast increase in buying, but machine tool dealers continue to receive inquiries that are regarded favorable.

The sales department of one of the city's leading machine tool producers said a satisfactory condition would result if one-half the inquiries develop into orders. They are from a well scattered area, but prospective purchasers are unwilling generally to accept the prices being quoted by the producers.

Inquiry among other industrial establishments reveals that most of them are operating to within 60 per cent or more of capacity. At J. G. Brill & Co., car builders, indications are for an increase in the present capacity within the next three months.

Among the smaller dealers in new and used tools inquiries show that locomotive repair tools are leading in demand. Repair work has increased and the general movement of used tools has been somewhat better than it was a year ago.

Cincinnati

Cincinnati machine tool manufacturers report that sales in the past week were excellent, passing the previous week's totals. Several manufacturers state that with them the feature of the week was an unusually large number of small orders, which made up a large total.

It is stated that a great many of the single purchases of high-efficiency tools made by users in the past few months were for the purpose of trying them out, and the economies effected are resulting in sales of additional tools of the same kind, as well as inquiries about rapid-production tools of other kinds.

In speaking of the large number of inquiries that are coming in, a manufacturer pointed out that if only a small percentage of these result in orders the plants will be kept very busy. Because of this possibility, buyers are advised to place orders as soon as they can.

Orders and inquiries received in the past week came from all sections of the country and from a large variety of industries. Buying by the automotive industries was fairly large. A good-sized order was received from India. Business from the South is said to be increasing.

Detroit

Evidences that sales of machinery and machine tools in Detroit and other industrial centers in southeastern Michigan are on the up-grade, are increasing with every week, and leading representatives of machinery manufacturers are more optimistic than for some time.

There is an apparent undercurrent of feeling that the approach of spring will find the automobile plants in full production and in the market for new tools and machinery.

The Oakland Motor Car Co., the Chrysler Motor Corporation, the Ford Motor Co., and the Reo Motor Car Co., appear to be the big buyers in the immediate future.

Ground has been broken at Pontiac for a $300,000 addition to the Oakland Motor Car Co. plant. The structure will contain the axle housing plant. New equipment to be installed will cost approximately $200,000.

A one-story building covering about six acres is being erected by the Chrysler Motor Corporation to be utilized for general manufacturing purposes.

The enameling division of the Reo plant at Lansing will be housed in a new building now under construction. The conveyor ovens and other equipment will be installed in April.

Machinery for the new hangar and airplane factory of the Ford Motor Co. at Dearborn is being purchased and will be ready for installation upon the completion of the new buildings. As a result of the redesigning of Ford cars by the engineers, ten giant presses were recently installed in the pressed steel building at the River Rouge plant to shape fenders from cold strip steel. Equipment which had turned out fenders of the former type, was not equal to the task of fashioning the tougher steel specified for the present model.

The amount of money to be spent on maintenance of good roads and the additional sums authorized for the building of more highway mileage, augurs well for manufacturers in 1926.

A considerable amount is to be expended in purchasing new equipment and machinery for the new plant of the Sheet Aluminum Corporation.

At the request of the highway commissioner the State Administrative Board has authorized the expenditure of $111,785 for the purchase of additional equipment. In accordance with this authorization the equipment and materials division will purchase 9 heavy scarifier graders, 22 one-man tractor graders, and 11 truck blades for the use of the highway department in Detroit.

During the next 30 days quotations will be received on 8 oil-burning tar kettles, 9 chloride distributors, 4 portable gravel screens, 3 small concrete mixers, 12 highway mowing machines and 1 truck crane.

Southern District

Though inquiries are showing a little more activity, business the last half of February was about on a par with the first half of the month. The month as a whole was just a little slower than had been expected, but comparing quite favorably with last year.

There is good inquiry for road building equipment, and several of the Southeastern states have either recently made good purchases for work this summer, or will do so in the near future. Dealers in Atlanta are interested in the legislation to authorize a large road bond issue. Should the measure pass it will mean good business in road equipment for dealers in Atlanta for the next three or four years.

Railroad inquiries are the next best in volume, and some fair sales have been made recently, though they are expected to be much more active by early spring. The outlook seems to promise as good a year as 1925, which was a record season, as many Southern roads are preparing for considerable construction in the coming summer months.

Sales to service stations and smaller shops are still off, nearly all the sales reported being for used or rebuilt equipment. The outlook is only fair, but there are many garages and service stations in process of construction that should furnish good business later on in the year.

Textile mill sales are rather quiet, but the outlook is for a pick-up in this business during March.

Farm machinery sales are opening up very well, tractors especially, and there is promise of equally as good a business as last year. General business in mill supplies is reported only fair.

Some sales are being made of woodworking machinery, and there have also been a few sales of brick making machinery, but as a whole this business is quiet for this time of the year.

What the Railroads Are Doing

The locomotive situation appears to have taken a turn for the better. Inquiries now pending include 113 for the Southern Railway, 23 for the Southern Pacific, 23 for Florida East Coast and 25 for Rock Island.

In addition well defined rumors in the trade are that Pennsylvania will shortly enter the market for 200 large engines. Including these, business in sight totals 384 engines. Averaging prices at $60,000 a unit, a conservative figure, this business involves over $23,000,000.

Railroad equipment orders placed last week included purchases of 500 refrigerator cars by the Northwestern Refrigerator Lines from the American Car and Foundry Co. The New York Central also ordered 10 passenger coaches from this same company and 500 automobile cars from the Merchants Dispatch Transportation Co. The St. Louis-San Francisco R.R. bought 750 steel underframes from the Tennessee Coal, Iron and Railroad Co.

The Illinois Central has placed orders for 2,300 gondolas, costing approximately $5,000,000, and divided as follows: 500 to the Pullman Car and Manufacturing Corporation; 600 to the Standard Steel Car Co.; 500 to the Illinois Car and Manufacturing Co.; 500 to the Mount Vernon Car and Manufacturing Co.; and 200 to the Ryan Car Co. The American Locomotive Co. reported an order for 23 three-cylinder engines of 221 tons each from the Southern Pacific Co.

The Chicago, Rock Island & Pacific is in the market for 25 locomotives and the Atchison, Topeka & Santa Fé has asked bids on 500 hopper cars. The Northern Pacific has ordered 10 new observation cars.

The Canadian Locomotive Co. has received an order for 20 Mikado freight locomotives from the Canadian Pacific Ry.

The St. Louis-San Francisco R.R. has ordered 750 steel underframes from the Tennessee Coal, Iron & Railroad Co.

The Seaboard Air Line Railway Co. has let contracts for the purchase of 2,400 fifty-ton gondola cars and 1,000 forty-ton box cars. The box cars will be built by the Pressed Steel Car Co. and the gondola cars are divided equally between the Pressed Steel Car, the American Car and Foundry Co. and the Standard Steel Car Co.

Orders for equipment costing approximately $8,000,000 are expected to be awarded in the next few weeks by railroads in the Chicago district. The roads expected to place orders are Illinois Central, 2,300 freight cars; Chicago & Eastern Illinois, 500 coal cars; Burlington, 500 coal cars, and Rock Island, 10 locomotives and five baggage cars. Inquiries for railroad equipment include 2,250 freight cars for the Southern Railway and 1,000 for the Northern Pacific.

The Rock Island has ordered 28,000 tons of rails from the Illinois Steel Co. and 5,000 tons from the Inland Steel. The St. Louis-Southwestern has placed 10,000 tons with the Illinois Steel and 3,200 tons with Bethlehem. The Missouri-Kansas-Texas has ordered 13,000 tons, mostly from the Tennessee Coal, Iron & Railroad Co., and the Minneapolis & St. Louis has purchased 5,000 tons from Chicago makers.

The Cooke plant of the American Locomotive Co. at Paterson, N. J., will be closed because of a lack of work, according to a statement issued last week by Secretary Robertson. He said that reopening of the plant depended on future orders.

The motive machinery, controls and other electrical equipment for six electric passenger locomotives and two double-cab switching locomotives have been awarded by the Pennsylvania Railroad to the Westinghouse Electric and Manufacturing Co. This equipment will be shipped to the Juniata shops of the Pennsylvania at Altoona, where the eight locomotives are to be built.

The Union Switch and Signal Co. has received contracts for 250 color light signals and other apparatus for the New York Central; 185 signals for the Nashville, Chattanooga & St. Louis; 74 three-color light signals and apparatus for the Cleveland, Cincinnati, Chicago & St. Louis; and three 12-way electro-pneumatic push-button machines for the Pennsylvania R.R.

The Boston & Maine R.R. has placed a contract with the Osgood Bradley Car Co., of Worcester, Mass., for ten gasoline-electric cars, two of them 73 ft. long, the others 61 ft. long, which will be used for branch line service. Each will be equipped with a 275-hp. gasoline engine, which will drive an electric generator, the current of which will pass to motors not mounted on the trucks.

Application for a charter for the Pennsylvania General Transit Co., to be organized by the Pennsylvania Railroad for operating motor buses, will be placed in the hands of the governor of Pennsylvania the latter part of next month. Charter as applied for will cover the right to operate motor conveyances of passengers and freight in the counties of Pennsylvania traversed by the railroad. The Pennsylvania plans to enter the business of transportation by motor bus or motor truck only when such operation is absolutely necessary to render service to its patrons, and at the same time reduce the operation of trains which decreasing patronage make unprofitable.

Correction

Garford Continues as President of Cleveland Automatic

A. L. Garford was re-elected president of the Cleveland Automatic Machine Co. at the directors' meeting on Jan. 30, and will continue to take an increasingly active part in the affairs of the company.

Last week's statement in the *American Machinist* in the "Personals" column to the effect that Mr. Garford had retired, was an error.

News of the Automotive Industry

Automobile manufacturers are evidently not adhering to the policy of aligning production with retail sales demand, as was the case during the early months of 1925. This condition is probably due to the greater confidence which has been fostered throughout the trade over the prospects of record sales during 1926. Figures at hand indicate a large percentage of the cars currently produced are being accumulated, mainly by dealers and distributors in anticipation of a strong spring market. It is estimated that fully 30 per cent of production during January remained unsold and that stocks of unsold cars increased fully 20 per cent during the month.

The record-breaking production in the first month of 1926 exceeded 330,000 cars and trucks, against 241,062 a year ago. January is normally one of the low production months and this performance would indicate a 40 per cent gain in production over 1925, or a final output of 6,000,000 vehicles this year against 4,300,000 last year, if other months continue to show the proportionate gain shown in January.

According to the Motor and Accessory Manufacturers' Association, shipments of automotive parts and accessories in January were 132 per cent of shipments in January, 1925.

Shipments for original equipment of cars and trucks aggregated 137 per cent and shipments to the wholesale and retail trade were 103 per cent in replacement parts, 127 per cent in accessories and 115 per cent in service equipment.

The Hudson Motor Car Co. last week increased production from 1,000 cars a day to 1,300 cars a day. In March it is planned to increase output to 1,700 cars a day, and thereafter by relays until a maximum of 2,300 cars a day is reached at the peak of the spring season. This schedule anticipates an output of approximately 40,000 cars a month for March, April, and May, or a probable total for the company's second fiscal quarter of 120,000 cars.

The work of increasing the capacity of the Buick factories to 1,200 cars a day has progressed so well that officials are confident of meeting the March schedule of 27,122 cars.

A new building will be erected for the manufacture of crankshafts. This building will have a floor space of 108,000 sq.ft. The space released by shifting the crankshaft division to the new building will be absorbed by other departments.

Personals

FREDERICK I. SANDERSON has been elected first vice-president of the Wellman-Seaver-Morgan Co., of Cleveland.

A. B. CUTLER has been appointed sales representative in the Middle-West for the Acme Electric Welder Co., of Los Angeles.

E. W. WATTS, president of the United States Machinery Co., of 136 Liberty St., New York, has returned from an extended business trip through continental Europe.

M. SCHILLER has been appointed vice-president in charge of purchases for the Superheater Co., of New York.

H. C. OSMAN, sales manager for the Nugent Steel Castings Co., of Chicago, has been elected secretary of the company. C. A. MacDonald has been elected treasurer.

J. T. TRUMBLE has resigned as assistant engineer of the Olds Motor Works, Lansing, Mich., to become chief engineer of the F. B. Stearns Co., of Cleveland.

E. J. BURCH has been promoted to the position of superintendent of the Michigan Central Railroad Co.'s shops in Jackson, Mich.

J. A. NICHOLS, JR., has resigned as vice-president in charge of sales of Dodge Bros., Inc. Mr. Nichols joined Dodge in 1914 and has been with the company ever since.

C. G. BIGELOW is now chief engineer for the Columbia Steel Co., of Butler, Pa. He was formerly associated with the Jones & Laughlin Steel Corporation.

J. W. FORDNEY, formerly chairman of the Ways and Means Committee of the House of Representatives, has been elected president of the Ruggles Motor Truck Co., of Saginaw, Mich.

J. E. HEETER has been appointed manager of the Philadelphia office of the Diamond Power Specialty Corporation. He succeeds M. J. Miller who has been transferred to the Detroit office.

L. C. FREEMAN has been appointed vice-president of the Gardner Motor Co., Inc., of St. Louis. Mr. Freeman will continue his duties as chief engineer and production manager of the organization.

J. W. PETERSON has been named manager of the Canton plant of the American Bridge Co. He succeeds H. L. Rankin, who will be manager of the company's Toledo plant.

PAUL L. GOSSETT has resigned as chief tool designer for the Stutz Motor Car Co. of America, Inc., and has joined the engineering staff of the Hercules Corporatioon, of Evansville, Ind.

C. FAYETTE TAYLOR, formerly motor engineer with the Wright Aeronautical Corporation, has joined the technical staff of the Massachusetts Institute of Technology as consulting mechanical engineer.

HERBERT GAD, Martin Bldg., Birmingham, Ala., has been appointed distributor in the Birmingham territory for construction machinery made by the Construction Machinery Co., of Waterloo, Iowa.

JOHN K. DESMOND, formerly Philadelphia district sales manager for the Crucible Steel Co. of America, has been appointed Philadelphia district manager for steel sales for Henry Disston & Sons, Inc., of Philadelphia.

CHARLES R. SHERMAN, formerly plant engineer with the Trumbull Electric Manufacturing Co., Plainville, Conn., has joined the organization of the Plainville Electric Products Co.

THOMAS H. PEARSALL, expert toolmaker and formerly mechanical supervisor of the Budd Body Co., of Philadelphia, has been appointed assistant superintendent of the New Home Sewing Machine Co., Orange, Mass.

JAMES C. HINES has joined the sales staff of the E. W. Bliss Co., of Brooklyn, N. Y., and will be attached to the sales division of the can making machinery department. Mr. Hines was for a number of years associated with the McDonald Machine Co., of Chicago.

WILLIAM P. FLEMING, manager of the Tampa, Fla., office for J. S. Schofield's Sons Co., of Macon, Ga., for some time, has been named sales manager of the Schofield-Burkett Construction Co., of Macon, manufacturers of excavating and other construction machinery.

E. ALLEN MOORE, chairman of the board of the Stanley Works, has retired from the directorate of the New Britain Machine Co., New Britain, Conn. When John H. Goss, of Waterbury, was elected chairman of the Board of the New Britain Machine Co., at the annual meeting, it became known that he had been serving in that position for the past few months. John W. Outerson of New Haven, Conn., retired as a director, and Frank G. Vibberts of the New Britain Trust Co., was elected to fill the vacancy. Other officers and directors were re-elected.

Business Items

The Stanley P. Rockwell Co., of Hartford, Conn., has moved its offices to 66 Trumbull St., in that city.

Detroit offices of the Hamilton Press and Machinery Co. have been removed from 516 Marquette Bldg., to 8316 Woodward Ave.

The Syracuse Supply Co., of Syracuse, N. Y., has been appointed sales representative in that territory for the Kingsbury Manufacturing Co., of Keene, N. H.

The Rapp-Huckins Co., Inc., of 59 Haverhill St., Boston, has been appointed district sales representative for the Climax Engineering Co., of Clinton, Iowa.

The Millholland Sales and Engineering Co., of Indianapolis, has been appointed sales agent in that territory for the Kingsbury Manufacturing Co., of Keene, N. H.

The American Hoist and Derrick Co., of St. Paul, Minn., has opened another branch office, at 1943 Railway Exchange Building, St. Louis, Mo., with Ward B. Maurer in charge.

The Clifford Peterson Tool Co., of Chicago, has purchased the building at 123-125 N. Jefferson St., in that city and will occupy the entire premises as soon as alterations are completed.

The Columbia Steel Co. has been organized in Pittsburgh, from a merger of the Forged Steel Wheel Co. and the Columbia Steel Co., of Elyria, Ohio. H. M. Naugle has been elected president of the new company. Headquarters have been established in the Standard Life Building, Pittsburgh.

A modern machine knife manufacturing department has been added to the branch factory of Henry Disston & Sons Inc., at Sixth and Baymiller Sts., Cincinnati. This branch factory will serve users in the Middle-West and parts of the South. Complete modern hardening and tempering equipment and machinery for grinding and beveling high-speed planer knives of all sizes has been installed.

Employees of the Gilbert & Barker Manufacturing Co., of West Springfield, Mass., to the number of 890, received 29,314 shares of common stock in the Standard Oil Co. of New Jersey, which controls the first named plant, as the first step in a profit participation plan. The shares, representing an aggregate value of approximately $1,250,000, were presented at a meeting in the recreation hall at the plant on Feb. 24. Vice-President C. C. Ramsdell presided.

The Cutler-Hammer Manufacturing Co., of Milwaukee, has established a new sales office in the Healey Bldg., Atlanta, Ga. A. C. Gibson, formerly of the Philadelphia office is in charge. This office will serve the trade in North Carolina, South Carolina, eastern Tennessee, Georgia, Florida, southern Alabama and Mississippi. The General Machinery Co., of Birmingham, will continue to serve the trade in northern Alabama.

The Climax Engineering Co., of Clinton, Iowa, announces the appointment of the Briggs-Weaver Co., of Dallas, Texas, as district representative. This organization will handle the sale of Climax engines for industrial purposes. The Clark Machine Co., of Wichita Falls, Texas, has also been appointed representative for the sale of Climax engines for oil drilling purposes. The Petroleum Electric Co., of Tulsa, Oklahoma, has taken on the sale of Climax engines in the Southwest. P. J. Dasey, Wells Hotel, Tulsa, Oklahoma, is in charge of the Southwestern sales territory.

Manning, Maxwell & Moore, Inc., have purchased the name, good will, drawings, patterns, etc., of the Detrick & Harvey Machine Co., Baltimore. They will continue the development and manufacture of the Detrick & Harvey line—particularly open-side and convertible planers, standard double-housing planers and horizontal boring machines. This work will be carried on at the plant of the Putnam Machine Works, at Fitchburg, Mass. J. W. Neidhardt, who has been president of the Detrick & Harvey Machine Co., will be associated with Manning, Maxwell & Moore, specializing in the Detrick & Harvey line. The present plant, machinery and equipment of the Detrick & Harvey Machine Co. will be liquidated.

Obituaries

ROBERT HOBSON, president of the Steel Co. of Canada, died at his home in Hamilton, Ontario, on Feb. 25.

DANIEL M. BRADY, founder of the Brady Brass Co., of New York, died suddenly in Atlantic City, N. J., on Feb. 24. He was 72 years old.

WILLIAM J. MILLS, founder and former president of the W. J. Mills Brass Works, of Brooklyn, N. Y., died at his home in that city on Feb. 24.

J. W. DUERR, sales manager of the McMyler-Interstate Co., of Bedford, Ohio, manufacturer of material handling equipment, died on Feb. 14. He was 45 years old.

WALTER B. MANNY, of Larchmont, N. Y., a director of the Burroughs Adding Machine Co., and president of the North American Copper Co., died on Feb. 25 in San Antonio, Texas.

FREDERICK KIEHLER, pioneer body designer, died at his home recently. He was at one time chief designer for Cadillac and later for Lincoln, and recently had been connected with the Briggs Manufacturing Co. in experimental work. He was 67 years old.

ROBERT E. RUSHTON, SR., one of the pioneers in the machinery and manufacturing field in the Southeast, identified for several years with the Winship Machine Co., of Atlanta, of which he was at one time secretary and treasurer, died at his home in Atlanta recently at the age of 77 years. He was one of the oldest native born citizens of Atlanta, having been born in the city in 1849 when Atlanta was no more than a small village. Some years ago he was stricken with paralysis while at his desk in the plant of the Winship company, and never fully recovered.

ANDREW C. CAMPBELL, president of the A. C. Campbell Co., and consulting mechanical engineer for the American Chain Co., died at his home in Waterbury, Conn., on Feb. 21. He was 69 years old. Mr. Campbell was widely known in engineering circles, having been an inventor of note in that field. He was a member of the American Society of Mechanical Engineers since 1885. At different times in his life he was associated with the Wheeler & Wilson Sewing Machine Co., the Waterbury Farrell Foundry and Machine Co., and the E. J. Manville Machine Co.

Calendar of Local Meetings

National Association of Cost Accountants

New York. March 9. "Rewarding the Workers," by Charles E. Bedaux.

Albany. March 10. Joint meeting with Foremen's Club.

Worcester. March 11. "The Relation of Selling Costs and Administration to Unit and Geographical Costs."

Philadelphia. March 12. The duties of a treasurer of an industrial company.

Mohawk Valley. March 15. "The Company's Cost Methods and the Uses Made of Cost Records." Visit to a plant at Utica, N. Y.

American Society for Steel Treating

Hartford. June. Spring sectional meeting.

American Society of Mechanical Engineers

New York. March 4. Engineering Societies' Building. "Water Purification for Textile Processes."

New Haven. March 9. At Mason Laboratory, Yale University. Joint meeting with student branch, Yale.

Baltimore. March 10. "Household Refrigeration," by R. H. Tillman.

Metropolitan. March 11. "Material Handling in Coal Mines."

Rochester. March 12. Joint meeting with the Rochester Engineering Society.

New York. March 17. Joint meeting of the founder societies.

New England Meeting. May 3 to 6. Providence, R. I. Chairman of program committee, Luther D. Burlingame.

Society of Automotive Engineers

Detroit Section. March 11. Speaker from the Bureau of Standards.

Indiana Section. March 11. Bus development meeting.

Cleveland Section. March 15. Subject not announced.

Detroit Section. March 25. Production meeting on automobile gearing.

Forthcoming Meetings

American Management Association. Annual convention, Hotel Astor, New York City, March 3, 4 and 5. Headquarters, 20 Vesey St., New York City.

National Railway Appliance Association. Annual meeting and exhibition, Coliseum and Annex, Chicago, March 8 to 11th. C. W. Kelley, secretary, 845 So. Wabash Ave., Chicago.

National Metal Trades Association. Twenty-eighth annual convention, Hotel Astor, New York, April 15 and 16. Secretary, J. E. Nyhan, Peoples Gas Bldg., Chicago, Ill.

National Foreign Trade Council. Thirteenth national foreign trade convention, Charleston, S. C., April 28, 29 and 30. O. K. Davis, secretary, India House, Hanover Square, New York.

American Gear Manufacturers' Association. Tenth annual meeting, Book-Cadillac Hotel, Detroit, May 13, 14 and 15. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

American Supply and Machinery Manufacturers' Association. Annual convention, Hotel Statler, St. Louis, week of May 17. F. D. Mitchell, secretary, 1819 Broadway, New York.

Society of Automotive Engineers. Summer meeting, French Lick Springs, Indiana, June 1 to 4. John Warner, manager of meetings, S. A. E., 29 West 29th St., New York City.

National Association of Purchasing Agents. Eleventh annual convention and exposition, Ambassador Hotel and Auditorium, Los Angeles, Calif., June 9 to 12. W. L. Chandler, secretary, Woolworth Bldg., New York.

Society of Industrial Engineers. Thirteenth national convention, Bellevue-Stratford Hotel, Philadelphia, June 16, 17 and 18. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago.

American Society for Testing Materials. Haddon Hall Hotel, Atlantic City, N. J., June 21 to 25. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia.

American Society of Mechanical Engineers. Spring meeting, Palace Hotel, San Francisco, Calif., June 28 to July 1. Chairman of convention, Warren H. McBride, the California and Hawaiian Sugar Refining Co., 215 Market St., San Francisco.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—Pig-iron prices, though firm, are slightly lower than a year ago. Steel quotations appear a trifle stronger than a month ago, particularly on plates. Demand is developing in the direction of steel structurals, pipe, wire products, and tin plate. Steel sheets and scrap tend downward. Current mill quotations on the principal hot-rolled products are: bars, $2; shapes, $1.90@$2; plates, $1.80 per 100 lb., Pittsburgh. This represents an advance of 5c. per 100 lb. in plates during month.

Non-Ferrous Materials — Maximum coke quotations dropped $1.25@$2 per ton at Connellsville during week. With the exception of copper, solder, and babbitt metal, non-ferrous metals show a slightly downward tendency.

(All prices as of Feb. 26)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	24.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.37
BIRMINGHAM	
No. 2 Foundry	22.00@23.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	24.16
Virginia No. 2	29.17
Basic	23.16
CHICAGO	
No. 2 Foundry local	23.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	22.27
Basic	22.27
Bessemer	22.27

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.50
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.40@2.50	3.89	3.25	3.50
No. 12	2.45@2.55	3.94	3.30	3.55
No. 14	2.50@2.60	3.99	3.35	3.60
No. 16	2.60@2.70	4.09	3.45	3.70
Black				
Nos. 18 to 20	3.05@3.15	4.30	3.90	3.90
Nos. 22 to 24	3.10@3.20	4.35	3.95	3.95
Nos. 26 and 27	3.15@3.25	4.40	4.00	4.00
No. 28	3.25@3.35	4.50	4.10	4.10
Galvanized				
No. 10	3.50@3.60	4.50	4.25	4.25
Nos. 12 to 14	3.60@3.70	4.60	4.35	4.35
No. 16	3.75@3.85	4.75	4.50	4.50
Nos. 18 to 20	3.90@4.00	4.90	4.65	4.65
Nos. 22 to 24	4.05@4.15	5.05	4.85	4.80
Nos. 26 and 27	4.20@4.30	5.20	5.10	4.95
No. 28	4.50@4.60	5.50	5.25	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness — Decimal	B.W.G. and Fractions	Outside Diameter in Inches ½	⅝	¾	⅞	1	1⅛	1¼
		Price per Foot						
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
.065″	16	.19	.20	.21	.22	.23	.25	.27
.083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109″	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.85	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.55	5.60	5.50
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.10
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	50@60%	55%	50%

Electric welding wire, New York, ⅛, 8.25c.; ¼, 7.85c.; ⅜ to ½, 7.35c. per lb. *Flat, 3/16@¼-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound			
Copper, electrolytic (up to carlots), New York			15.37½
Tin, 5-ton lots, New York			66.00
Lead (up to carlots) E. St. Louis	8.80	New York	9.62½
Zinc (up to carlots) E. St. Louis	7.50	New York	8.62½

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	23.00	24.50	26.00
Copper sheets, base	22.75	22.75	22.75
Copper wire, base	19.62½	16.50	16.25@16.50
Copper bars, base	22.37½	22.37½	22.37½
Copper tubing, base	24.50	24.50	24.50
Brass sheets, base	19.12½	19.12½	19.12½
Brass tubing, base	23.75	23.75	23.25
Brass rods, base	16.87½	16.87½	16.87½
Brass wire, base	19.62½	19.62½	19.62½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	27.00	27.00	27.02
Zinc sheets (casks)	12.00	12.60@12.95	12.27
Solder (½ and ½), (case lots)	40.62½	41.00	38@42
Babbitt metal, delivered, New York, cents per lb.:			
Genuine, highest grade			81.50
Commercial genuine, intermediate grade			56.00
Anti-friction metal, general service			31.50
No. 4 babbitt (f.o.b.)			14.50
Nickel, f.o.b. refinery, cents per lb.:			
Ingots 31.00 Electrolytic 38.00 Shot			32.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.25@12.50	11.25	11.50@12.00
Copper, heavy, and wire	11.50@12.12½	11.50	11.00@11.50
Copper, light, and bottoms	10.00@10.50	9.50	10.00@10.50
Heavy lead	8.00@8.25	7.50	7.50@8.00
Tea lead	5.50@6.00	5.00	6.50@7.00
Brass, heavy, yellow	7.50@8.00	7.25	7.75@8.25
Brass, heavy, red	9.50@10.00	9.50	8.75@9.25
Brass, light	6.25@6.50	6.00	7.25@7.75
No. 1 yellow rod turnings	8.50@9.00	8.00	7.75@8.25
Zinc	4.75@5.00	4.75	4.50@5.00

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$11.25	$11.45	$11.50
"A" Grade:				
IC,	14x20	8.85	9.40	9.50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.85	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.15@0.22	$0.19	$0.20
Cotton waste, colored, per lb.	.10@.15½	.10	.17
Wiping cloths, washed white, per lb	.18	36.00 per M	.16
Sal soda, per 100 lb. keg	2.25	2.25	2.75*
Roll sulphur, per 100 lb. keg	3.75	3.35	5.00
Linseed oil, per gal., 5 bbl. lots	.87¾	1.02	.88
Lard cutting oil, 25% lard, per gal.	.55	.50	.48
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.35	.35	.29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.0415
Brass rods	per lb	.1687½	.1687½	.1762½
Solder (½ and ½)	per lb.	.4062½	.3975	.42
Cotton waste	per lb.	.15@.22	.15@.22	15@22
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.60
Machine oil	per gal.	.35	.35	.33
Belting, leather, medium	off list	40–5%	40–5%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	45%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.56	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.45	1.49
Cloth	3.55	3.55	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		4.00@4.25
Coke, prompt foundry, Connellsville	per net ton		4.75@5.00
White lead, dry or in oil	100 lb. kegs	New York, 15.25	
Red lead, dry	100 lb. kegs	New York, 15.25	
Red lead, in oil	100 lb. kegs	New York, 16.75	

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{A}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ½x½-in., 2c. each. Discount 70% for $\frac{5}{16}$-in and smaller and 65% for ⅜-in. and larger.
Case hardened ½x½-in., 6c. each, less 50%.

Rivets, button heads, ¾-in., ⅞-in., 1-in. diam. x2$\frac{A}{16}$-in. to 4½-in. $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{7}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb for 1½ to 2-in. long, all diameters, 25c.; ½-in. dia., 35c.; ⅝-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses; ⅝-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Miss., Columbus — J. M. Jacobs, College and Sixth Sts.—equipment including power hack saws, wire working machines, forges, etc. for proposed 25 x 100 ft. foundry and machine shop. $50,000.

Miss., Columbus—F. M. Smith, College St.—equipment for foundry and machine shop.

Mo., Kansas City — The Gille Mfg. Co., 1423 West Ninth St.—additional machinery for the manufacture of metal cans and containers for proposed extension to plant.

N. Y., Buffalo—Republic Metalware Co., 80 Tennessee St. — stamping machines, presses, small tools, etc. for proposed factory. Estimated cost $60,000.

N. Y., Buffalo—W. P. Stranahan, 15 East Pickham St. (manufacturer of auto fenders, motor parts, etc.)—machine tools, bench tools, small press and lathe.

N. Y., Dunkirk—Sanitary Receiver Co.—36 in. Niagara power bar folder.

N. Y., New York—G. Danzis Co., Inc., 47 Ann St. (toolmakers)—20 to 30 in. shaper.

N. Y., New York—Quality Art Novelty Co., 18 West 18th St.—44 in. Seybold cutter.

N. C., Roseboro—Roseboro Mills, Inc.—16 in. lathe 10 ft. bed, Universal milling machine, drill press and emery wheels.

Tex., Electra—W. P. Lincoln—machinery, etc, for the manufacture of tanks for proposed 1 story factory. Estimated cost $25,000.

Wis., London—Febock & Nottestad—shop tools, bench tools and auto repair machinery.

Wis., Milwaukee — Mack International Truck Co., 410 Prospect Ave.—machinery for the repair of trucks for proposed 1 story, 192 x 425 ft. service building. Estimated cost $325,000.

Wis., Racine — Wisconsin Cylinder Foundry Co., 1308 18th Ave.—foundry equipment for proposed 1 story, 42 x 60 ft. foundry. Estimated cost $10,000.

N. S., New Glasgow—I. Matheson Co., Trenton Road, I. Matheson, Purch. Agt.—complete foundry equipment to replace fire loss. Estimated cost $50,000.

Ont., Guelph—A. Rae, Yarmouth St.—equipment for the manufacture of auto truck bodies and delivery wagons. Estimated cost $50,000.

Ont., Hamilton—Canada Wire Co., 25 Ferguson Ave., A. Donald, Mgr.—complete equipment for pattern and machine shops to replace fire loss. Estimated cost $25,000.

Ont., Hamilton—F. Chadwick Brass Co., 12 Ferguson Ave.—machinery and equipment for plant to replace fire loss. Estimated cost $45,000.

Ont., Hamilton — James E. Riddell & Sons, 20 Ferguson Ave., (sheet metal work) complete equipment for plant to replace fire loss. Estimated cost $50,000.

Ont., Hamilton—Steel Co. of Canada—complete equipment for proposed galvanizing plant. Estimated cost $300,000.

Que., Montreal—Allard & Bourque, 7 St. Alexander St.—machinery and equipment for repair shop.

Que., Montreal—Victory Tool Co., 96 Rose de Lima St. (machinists, etc.)—additional machine shop equipment.

Australia — Melbourne — Victorian Government Railways, will receive bids until April 21 for plate bending rolls, etc.

Opportunities for Future Business

Ala., Sheffield — The King Mfg. Co., 230 South Clark St., Chicago, Ill., manufacturers of steel-lighting standards, will soon award contract for the construction of a 1 story, 140 x 175 ft. branch plant including foundry, machine and pattern shops, etc., here. Estimated cost with equipment $65,000. J. J. Greenfield, c/o owner, Ch. Engr.

Calif., Alameda—Bd. of Education, W. G. Paden, Secy., will soon receive bids for the construction of additions to high school including mechanics' shop, etc.

Calif., Lankershim—State Highway Commission, will receive bids until March 15 for the construction of storage, repair shops, etc., for road building equipment. R. M. Morton, Forum Bldg., Sacramento, Engr.

Calif., Oakland — California Wire & Cable Co., 564 Market St., San Francisco, had plans prepared for the construction of a 1 story addition to factory at 81st Ave., here. Estimated cost to exceed $40,000. Austin Co., 244 Kearny St., San Francisco, Archt. and Engr.

Calif., Redwood City—City awarded contract for the construction of a 1 story, 25 x 40 ft. machine shop. Noted Feb. 18.

Calif., San Francisco — Bd. of Harbor Commissioners, Ferry Bldg., plans the construction of machine shops on waterfront. Estimated cost to exceed $10,000. F. G. White, Ch. Engr.

Calif., San Francisco—J. A. Roebling & Sons Co., 646 Folsom St., manufacturers of wire rope, etc., having revised plans prepared for the construction of a 2 story factory and warehouse at DeHaro and Carolina Sts. Estimated cost $200,000. Private plans. Noted Aug. 20.

Calif., Santa Rosa—E. F. & H. P. Sophey, plan rebuilding 1 story, 120 x 200 ft. auto body and truck plant at Third and A Sts.

Calif., Stockton—Pacific Gas & Electric Co., 245 Market St., San Francisco, plans the construction of a 26 x 72 ft. garage annex and 50 x 72 ft. machine shop, here. Estimated cost $9,500. Private plans.

Conn., Waterbury—Lux Clock Mfg. Co., 97 Sperry St., awarded contract for the construction of a 5 story, 50 x 322 ft. factory. Noted Jan. 7.

Ga., Rome—E. P. Grant & J. M. Berry, plan the construction of a stove foundry.

Ill., Chicago—N. Shure, 4537 Fulton St., manufacturers of toys and novelties, awarded contract for the construction of a 99 x 100 ft. addition to factory. Estimated cost $150,000.

Ill., Chicago—Universal Stamping & Mfg. Co., 1925 South Western Ave., awarded contract for the construction of a 1 story, 108 x 175 ft. factory at 2841 North Western Ave. Estimated cost $58,000.

Ill., Waukegan—Waukegan Foundry Co., Terminal Bldg., is having preliminary plans prepared for the construction of a 1 and 2 story, 87 x 254 ft. iron foundry.

Ia., Des Moines—J. A. Raymaker, Consulting Engr., c/o Woods Bros. Thresher Co., owner, will receive bids until March 15 for the construction of 2 manufacturing buildings, 160 x 500 and 80 x 340 ft. including 28 x 340 ft. saw tooth units, etc.

Ia., Marshalltown—Fisher Governor Co., manufacturers of steam specialties and milling machines, will soon award contract for the construction of a 1 story, 60 x 60 ft. factory. Estimated cost $40,000. H. E. Reimer, Archt. and Engr.

Md., Baltimore—Ramp Building Corp., 21 East 40th St., New York, N. Y., is having plans prepared for the construction of a 5 story, 100 x 100 ft. garage at Water and South Sts. here. Estimated cost $300,000. F. W. Moe, c/o owners, Ch. Engr.

Mass., Cambridge (Boston P. O.)—Boston Elevated Railway, E. Dana, Gen. Mgr., Park Square Bldg., Boston, Mass., plans the construction of car barns and shops at Fresh Pond here. Estimated cost $200,000.

Mass., Hopedale — Draper Corp., textile machinery, will build additions to foundry. F. P. Sheldon & Sons, 1008 Hospital Trust Bldg., Providence, R. I., Archts.

Mich., Detroit—Chevrolet Motor Car Co., 3044 West Grand Blvd., awarded contract for the construction of a 3 story, 150 x 150 ft. garage on Amsterdam Ave. Estimated cost $160,000. Noted Feb. 11.

Mich., Muskegon—The Piston Ring Co., is having plans prepared for the construction of a 4 story, 122 x 125 ft. factory on Sanford St. Estimated cost $100,000. E. Young, c/o owner, Engr.

N. J., Fernwood (mail Trenton Junction) Ajax Electrothermic Corp., G. H. Clamer, Pres., 636 East State St., manufacturers of high frequency induction furnaces, is having plans prepared for the construction of a 1 story, 60 x 200 ft. factory, 2 story 40 x 42 ft. office. Estimated cost $60,000 to $80,000. E. Ward Easby, Inc., Schaff Bldg., Philadelphia, Pa., is engineer.

N. J., Glassboro — Advance Machine & Foundry Co., C. Peterman, Pres., will soon receive bids for the construction of a foundry and machine shop. Estimated cost $70,000.

N. Y., New York—The Benedict Metal Works, Inc., 1654 Webster Ave., manufacturers of drawn metal products, etc., had plans prepared for the construction of a 3 story addition to plant. Estimated cost $40,000 to $50,000.

O., Canton — Eberman Steel Co., 1103 18th St. N. W., manufacturers of structural steel, will soon receive bids for the construction of a 1 story factory on Allen Ave. S. E. Estimated cost $100,000. Noted Jan. 7.

O., Cleveland—W. S. Tyler Co., C. Zimmerman, Secy. and Treas., 3615 Superior Ave. (ornamental iron work) had plans prepared for the construction of a 2 story, 68 x 119 ft. addition to factory on East 36th St. Estimated cost $60,000. George S. Rider Co., Century Bldg., Archt. Noted Jan. 28.

O., Dayton — York Supply Co., Greenville, manufacturers of auto accessories, is having plans prepared for the construction of a 3 story, 40 x 120 ft. factory on East 3rd St., here. Estimated cost $100,000. Frank Hill Smith, Inc., Winters Bldg., Dayton, Archt.

O., Marion — Fairfield Engineering Co., H. B. Walker, Pres., manufacturers of conveying and other machinery, will build a 1 story, 60 x 65 ft. machine shop. Estimated cost $7,500.

Pa., Allentown—International Motor Car Co., will build a 1 story, 600 x 800 ft. auto factory. Estimated cost $400,000. L. H. Cutten, c/o owner, Engr.

Pa., Philadelphia—Brown & Sons, 145 Fairmount Ave., plans the construction of an auto sales and service building at 47th St. and Baltimore Ave. Estimated cost $1,000,000. I. W. Levin, 1011 Chestnut St., Archt.

Tex., San Antonio—R. Broge, 1320 North Alamo St., awarded contract for the construction of a 2 story, 42 x 120 ft. wire and metal works plant. Estimated cost $40,000.

Wis., London — Febock & Nottestad, awarded contract for the construction of a 1 story, 60 x 100 ft. repair shop. Estimated cost $40,000.

Wis., Milwaukee — J. Ruesch Printing Machinery Co., 485 Broadway is having plans prepared for the construction of a 3 story, 30 x 120 ft. manufacturing plant. Estimated cost $50,000. W. J. Kozick, 664 26th St., Archt. Noted Feb. 18.

Wis., Park Falls—Flambeau Paper Co., is having plans prepared for the construction of machine, carpenter and locomotive shops. Estimated cost $150,000. Brust & Philipp, 405 Broadway, Milwaukee, Archts.